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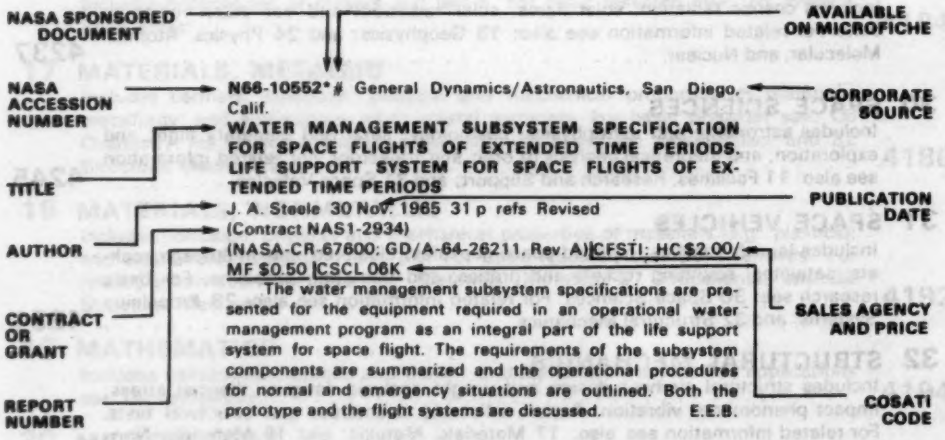
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N66-10552*# General Dynamics/Astronautics, San Diego, Calif.
CORPORATE SOURCE
TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
AUTHOR
J. A. Steele 30 Nov. 1965 31 p refs Revised
(Contract NAS1-2934)
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K
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REPORT NUMBER
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.
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VOLUME 4 NUMBER 21

Scientific and Technical Aerospace Reports

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November 8, 1966

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-35547*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NEWTONIAN AERODYNAMICS FOR GENERAL SURFACES

Willi H. Heybey *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 2-10 ref (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

In the hypersonic regime the Newtonian flow model, especially in its modified form, has been known for some time to produce satisfactory results regarding a number of basic body shapes. It may reasonably be expected to also work well with more complicated body geometries as presented, e.g., by re-entry vehicles. Because of its simplicity, the components of the aerodynamic force and the location of the centroid can be calculated in a relatively easy manner. The mathematics pertaining to the unmodified approach were developed here for a general surface given in analytic terms. Applications were made to the elliptic cone, first without, then with, an attached rear cylinder, to a conoid of biparabolic cross sections, and to a drop-like blunt body. The modification merely amounted to the changing of a constant; it is described in the last section where a survey of results as compared with otherwise known data is also given. Author

N66-35549*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ON QUASI-SLENDER BODY THEORY FOR OSCILLATING LOW ASPECT RATIO WINGS AND BODIES OF REVOLUTION IN SUPERSONIC FLOW

W. F. Platzer *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 26-32 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

A new formulation of quasi-slender body theory for oscillating low aspect ratio wings and bodies of revolution is presented making use of concepts to analyze the steady flow field around low aspect ratio wings at zero angle of attack. It also presents a new elementary approach to quasi-slender body theory for slowly oscillating bodies of revolution showing the interrelationship between the methods of W. H. Dorrance and Adams-Sears. The range of validity of quasi-slender body theory is examined by comparing it with an exact solution of the linearized unsteady potential equation. Such a solution is found for the infinitely long oscillating cylinder. Author

N66-36119*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

USE OF GRIT-TYPE BOUNDARY-LAYER-TRANSITION TRIPS ON WIND-TUNNEL MODELS

Albert L. Braslow, Raymond M. Hicks (NASA. Ames Res. Center), and Roy V. Harris, Jr. Washington, NASA, Sep. 1966 20 p refs Presented at the Conf. on Aircraft Aerodyn., Langley Sta., Va., 23-25 May 1966

(NASA-TN-D-3579) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Some general guidelines that are applicable to grit-type boundary layer transition trips located near the leading edges of model components are presented. Conditions that permit transition to be fixed at the roughness at subsonic and supersonic speeds without a resultant grit drag are reviewed. In certain cases in which grit drag is unavoidable, two methods—the choice of which depends upon the characteristics of the wind tunnel used—for correcting such drag are discussed. At hypersonic speeds, the problem of fixing boundary layer transition without distorting the turbulent boundary layer velocity profile has not been solved. Author

N66-36141*# National Aeronautics and Space Administration, Washington, D. C.

AERODYNAMIC DISTURBANCES OF PROFILES IN SUBSONIC STEADY FLOW [OB AERODINAMICHESKOY INTERFERENTSII PROFILEY V DOZVUKOM NESTATSIONARNOM POTOKE]

V. B. Kurzin Sep. 1966 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (USSR), no. 1, 1966 p 117-120

(NASA-TT-F-10293) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Aerodynamic forces on a system of N thin slightly twisted profiles having a small angle of attack in a two-dimensional subsonic flow were calculated. Specifically investigated is the effect of acoustic resonance in the case when the profiles perform arbitrary small harmonic oscillations. The system of N integral equations describing the gas flow is examined. The acoustic resonance is a characteristic feature of the aerodynamic interference of profiles oscillating in compressible flow. In the resonance region, the aerodynamic

forces differ appreciably from the corresponding forces in incompressible flow, and also from the case of a single oscillating profile. The effect of a neighboring profile is then of the same order as the total force acting on the profile, and the aerodynamic damping exhibits an abrupt drop in the resonance region. The effect of resonance is particularly pronounced at high oscillation frequencies. Author

N66-36142*# National Aeronautics and Space Administration, Washington, D. C.

METHOD OF CALCULATING THE EFFECT OF A GUST ON AN ARBITRARY THIN WING [METOD RASCHETA VOZDEYSTVIYA PORYVA NA PROIZVOL'NOYE TONKOYE KRYLO]

S. M. Belotserkovskiy Sep. 1966 28 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (USSR), no. 1, 1966 p 51–60

(NASA-TT-F-10294) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A numerical method of calculating unsteady flow past a thin wing moving in an ideal incompressible medium is developed with the aid of a diagram of a supporting surface. Since the time and coordinate dependences of the boundary conditions on the wing surface can be any desired, the proposed method can be used to study aperiodic motion of the wing as a solid body, arbitrary deformations of the wing, entry of the wing into a gust, the effect of a weak shock wave on the wing, etc. The method is applicable to monoplane wings of any shape in the plane, to annular wings, to systems of similar wings, etc. A detailed summary of articles which compute the influence of a gust on a wing is included. The effective solution of the problem is only obtained for a profile in the case of subsonic velocities. Author

N66-36164 Royal Aeronautical Society, London (England). Transonic Aerodynamics Committee.

METHOD FOR THE RAPID ESTIMATION OF THEORETICAL SPANWISE LOADING DUE TO A CHANGE OF INCIDENCE

Mar. 1964 16 p refs

(TD-MEMO-6403)

A method is presented for the rapid estimation of the spanwise load distribution over uncambered and untwisted wings in unseparated subcritical flow. It covers a wide range of planforms having (a) arbitrary leading edges and unswept trailing edges, (b) straight or cranked leading edges and arbitrary trailing edges. In addition a special modification allows for sweptback planforms having curved leading edges with continuous slope and streamwise tips of zero chord. The first step in the method evaluates the spanwise center of pressure and may be useful in its own right. When coupled with a corresponding method for local aerodynamic center, the procedure may often be an adequate substitute for calculations by lifting-surface theory to obtain the incremental loading due to a change of lift coefficient. Therefore, it may also be useful as a preliminary step in the Weber method of calculating the chordwise pressure distribution on thick swept wings. The method, derived by Garner, is based on numerous calculations by Multhopp's subsonic lifting-surface theory. Comparisons are made with experimental data as well as with the basic calculations. Author

N66-36166 Royal Aeronautical Society, London (England). Transonic Aerodynamics Committee.

METHOD FOR PREDICTING THE PRESSURE DISTRIBUTION ON SWEPT WINGS WITH SUBSONIC ATTACHED FLOW

Dec. 1963 53 p refs

(TD-MEMO-6312)

This memorandum explains in detail a formula which has been widely used to predict the pressure distribution on swept wings at subsonic speeds. The basic formula is quoted first in Section 3 for compressible flow; Section 4 quotes the corresponding formula for incompressible flow, and explains in detail the significance of the various terms and the way in which they should be interpreted in a practical calculation. Section 5 develops the linearized version of the formula for compressible flow. Section 7 gives some ancillary relations, including the formula for the evaluation of the pressure coefficient in compressible flow, and Section 8 outlines some practical limitations of the method, and some ways in which these may be circumvented. The application of the method to wings in combination with fuselages and other bodies is outlined. Section 9 presents a bibliography of papers which are relevant to the construction of the method outlined here, and section 10 presents tables and charts of the principal special functions used in the work. Author

N66-36168# Royal Aeronautical Society, London (England). Transonic Aerodynamics Committee.

A METHOD OF ESTIMATING DRAG-RISE MACH NUMBER FOR TWO-DIMENSIONAL AEROFOIL SECTIONS

Jul. 1964 48 p refs

(TD-MEMO-6407)

The Mach number is defined as that beyond which any further increase would lead to a rapid increase of drag coefficient due to the development of shock-wave drag. It is evaluated as a function of lift coefficient. The method is based on the observation that the shock-wave drag first develops rapidly as the shock wave moves downstream away from the airfoil crest, and therefore that the drag-rise Mach number is that at which the shock coincides with the crest. Predicting the drag-rise Mach number is thus reduced to predicting the Mach number for shock-at-crest, which is achieved by applying a simple criterion to the subsonic pressure distribution. The validity of the method was demonstrated by comparison with experimental data for a large number of airfoils. It is concluded that the present method should predict the Mach number for the rapid drag-rise to an accuracy of ±0.015 for the majority of cases. For a few particular cases of airfoil shape and pressure distribution a slow but significant growth of shock wave drag may precede the rapid increase predicted by the present method; a procedure is included for recognizing these cases. Author

N66-36176# College of Aeronautics, Cranfield (England).

A METHOD OF PREDICTING THE AERODYNAMIC BLOCKAGE OF BLUFF BODIES IN A DUCTED AIRSTREAM

A. H. Lefebvre Nov. 1965 21 p refs

(COA-AERO-188) CFSTI: HC $1.00/MF $0.50

Consideration is given to the flow conditions in the vicinity of a bluff body immersed in a ducted airstream. By equating the pressure loss expressed in terms of drag coefficient and physical blockage to the pressure loss occurring in the flow expansion downstream of the plane of maximum aerodynamic blockage, a relationship between geometric and aerodynamic blockage is obtained of the form

$$\left[\frac{1}{(1-B_g)^2}-1\right] = \phi \frac{\omega_g}{(1-B_g)^2}$$

where B_g is the geometric blockage, B_a is the aerodynamic blockage and ϕ is a function of the drag coefficient. It is argued that for any given body shape ϕ is constant, and supporting experimental evidence is presented which shows, in addition, that for circular cones with apex pointing upstream, $\phi = 0.44 (\sin\theta/2)^{0.5}$, θ being the included angle of the cone. Author

N66-36220# RAND Corp., Santa Monica, Calif.

THE HYPERSONIC VISCOUS SHOCK LAYER WITH MASS TRANSFER

S. Y. Chen, J. Aroesty, and R. Mobley May 1966 42 p refs (Contract AF 49(638)-1700)
(RM-4631-PR; AD-635971) CFSTI: HC $2.00/MF $0.50

An investigation of the effects of surface mass transfer on the viscous hypersonic shock layer of a blunt body was performed. Cheng's theory of the Newtonian shock layer was modified to include both suction and injection, and extensive numerical results were obtained for the injection of air into air. These results indicate that the heat-transfer and skin-friction reductions due to injection can be adequately represented by the standard boundary-layer correlation formula for all but extreme low-density flows. As the Reynolds number decreases, however, mass transfer becomes ineffective in reducing heating rates and skin friction, especially for a very cold wall. The effect of nonzero wall temperature is to increase the shock-layer thickness dramatically, and there are also indications that the wall-temperature level determines whether the asymptotic inviscid-shock-layer thickness is approached from above or below. Author (TAB)

N66-36298# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF THE BASE PRESSURE NEAR THE TRAILING EDGE OF AXISYMMETRIC BODIES IN SUPERSONIC FLOW
Iu. A. Panov and A. I. Shvets [1966] 9 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), v. 2, no. 6, 1966 p 105–111

To clarify the dependence of the stream parameters near the base section on the shape of the nose section, experiments were carried out in a supersonic wind tunnel at M = 1.5 to 3.25. The Reynolds numbers were computed by means of the flow parameters at the outer boundary of the boundary layer, and a linear dimension equal to the distance between the forward stagnation point and the trailing edge of the model. The models had fundamental cylindrical and interchangeable nose sections of two shapes: elliptical, and flat endplates with rounded, forward side edges. The pressure distribution on the lateral surface and the base portion was measured by mercury manometers; the static pressure was measured at the wall of the model and considered constant across the flow. Previously obtained data are reviewed and assessed, and figures are included to compare these findings with the experimental results obtained. M.G.J.

N66-36299# Lockheed Missiles and Space Co., Palo Alto, Calif.
HYPERSONIC GAS FLOW AROUND BLUNT BODIES TAKING RADIATION INTO ACCOUNT
V. N. Fomin [1966] 17 p refs Transl. into ENGLISH from Vychislitel'naya Mats. i Matem. Fiz. (USSR), v. 6, no. 4, 1966 p 714–726

The hypersonic flow of a gas incident at constant velocity on a plane or axisymmetric blunt body is considered, in which the gas behind the detached shock is assumed to be ionized and in equilibrium dissociation. A system of integral equations is given for computing the flow in the domain bounded by the shock, the axis of symmetry, the body surface, and the boundary characteristic drawn between the body and the shock. The coordinate system used in solving the problem is depicted. As the energy equation may not be represented as a finite relationship when taking account of radiation, an approximate ordinary differential equation is substituted, and an approximate system consisting of six equations is obtained. The results of the computations show that the magnitude of the shock wave stand-off from the streamlined body surface decreases when radiation is considered. M.G.J.

N66-36304*# Itek Corp., Palo Alto, Calif.
PREDICTED AND MEASURED PERFORMANCE OF TWO FULL-SCALE DUCTED PROPELLERS
A. R. Kriebel and M. R. Mendenhall Washington, NASA, Sep. 1966 121 p refs
(Contract NAS2-2847)
(NASA-CR-578) CFSTI: HC $3.00/MF $1.00 CSCL 01A

A theoretical study was made of the ability of previously developed theory for a ducted propeller at angle of attack to predict duct-to-propeller thrust ratio, normal force, and pitching moment. The theoretical predictions were extended to include duct pressure distribution, boundary-layer characteristics, and duct stall boundary. The methods were evaluated by use of wind-tunnel data for two large-scale duct propeller models. Data available consisted of overall thrust, normal force and pitching moment, duct surface pressure distribution, total pressure surveys at three axial stations in the duct, and a duct stall boundary deduced from tufts, sound, and pitching moment data. On the basis of the extended theory and data, an analytical model was developed which represents the propeller as a uniformly loaded actuator disk and the duct as a thin cylinder for purposes of computing forces and moments and as a thick, cambered ring airfoil for computing duct pressures and boundary layers. Author

N66-36321*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LARGE-SCALE WIND-TUNNEL TESTS OF A LOW-ASPECT-RATIO DELTA-WINGED MODEL EQUIPPED WITH SHARP-EDGED STRAKES
Victor R. Corsiglia and David G. Koenig Washington, NASA, Sep. 1966 51 p refs
(NASA-TN-D-3621) CFSTI: HC $2.50/MF $0.50 CSCL 01A

A wind-tunnel investigation was made to determine the longitudinal stability, lift, and landing and take-off performance of a delta-wing configuration equipped with strakes. The model was a wing, fuselage, vertical-tail combination. Four wing strake configurations were investigated. Some data were obtained with the model in the proximity of the ground. The strakes were found to increase lift coefficient significantly at angles of attack above about 12°. However, the increase in lift coefficient was accompanied by a reduction of static longitudinal stability. Author

N66-36347# Eidgenossische Technische Hochschule, Zurich (Switzerland).
SIMPLIFIED DESIGN THEORY FOR HIGHLY LOADED AXIAL COMPRESSOR ROTORS AND EXPERIMENTAL STUDY OF TWO TRANSONIC EXAMPLES
Arthur John Wennerstrom (Ph.D. Thesis) 1965 171 p refs
(Rept.-3652) CFSTI: HC $4.00/MF $1.00

A study of quasi-three-dimensional, axisymmetric flow of compressible fluids through axial-compressor rotors under the influence of annulus wall curvature and radial entropy gradients, is reported. A method is presented whereby wall curvature and various radial gradients may be considered during rotor design. Wall curvature is considered by solving the radial-equilibrium equation in orthogonal curvilinear coordinates which are approximately coincident with the stream-surface pattern. Radial gradients of all thermodynamic parameters may be handled by numerical integration and a simplified method is presented for treating entropy gradients in free-vortex design. Two rotors were constructed according to the developed design method and experimentally tested. The first test rotor was not successful due to a mechanical restriction placed on hub solidity. This restriction was relaxed for the second design which proved moderately successful and fulfilled design expectations. The radial variations in performance are presented and discussed in addition to mass-averaged performance of the overall rotor. Correlation of theory and experiment is shown to be generally compatible. S.C.W.

N66-36376*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
METHOD FOR ESTIMATING LIFT INTERFERENCE OF WING-BODY COMBINATIONS AT SUPERSONIC SPEEDS
Jack N. Nielsen and George E. Kaattari Washington, NACA. 31 Dec. 1951 47 p refs
(NACA-RM-A51J04) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

The modified slender-body method used to predict the lift and moment interference of triangular wing-body combinations has been adapted to combinations with other than triangular wings. That part of the method for predicting the effect of the body on the wing has been retained, but a new method for predicting the effect of the wing on the body has been presented. These methods have been applied to the prediction of the lift-curve slopes of nearly 100 triangular, rectangular, and trapezoidal wing-body configurations. The estimated and experimental values for the lift-curve slopes agree for most of the cases within ±10 percent. Some of the higher-order effects that must be taken into account in a theory that is to give greater accuracy than the present one are discussed. A numerical example illustrating the method is included. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-35346# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
PROCEEDINGS, AFCRL SCIENTIFIC BALLOON WORKSHOP, 1965
Arthur O. Korn, Jr., ed. May 1966 121 p refs Workshop held Sep. 1965 *Its* Spec. Rept.-45
(AFCRL-66-309; AD-634765) CFSTI: HC $4.00/MF $0.75

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4. SOME BALLOON MATERIALS TESTING METHODS R. H. Hauser (Hauser Res. and Eng. Co.) p 11-22 refs (See N66-35348 21-15)
5. THE AFCRL FLYING THREAD LOOM PROCESS FOR IMPROVED SCRIM-REINFORCED BALLOON MATERIALS (ABSTRACT) A. O. Korn, Jr. p 23
6. BALLOON RECOVERY SYSTEMS J. C. Payne p 25-30 (See N66-35349 21-02)
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9. BALLOON PERFORMANCE ANALYSIS-NCAR SCIENTIFIC BALLOON FACILITY T. W. Bilhorn (Natl. Center for Atmospheric Res.) p 59-63 (See N66-35352 21-02)
10. TANDEM BALLOON SYSTEMS R. D. Moroney (Schjeldahl (G. T.) Co.) p 65-75 (See N66-35353 21-02)
11. AFCRL TETHERED-BALLOON PROGRAMS W. R. Ferguson p 77-95 refs (See N66-35354 21-02)
12. VHF-HF OMNIDIRECTIONAL BALLOON LOCATING SYSTEM J. H. Crummie p 97-102 (See N66-35355 21-07)
13. FLIGHT EXPERIENCE WITH BALLOONS HAVING MEANS OF STRESS CONTROL IN THE BUBBLE J. A. Winker (Raven Ind.) p 103-117 (See N66-35356 21-02)

N66-35347# Winzen Research, Inc., Minneapolis, Minn.
STRATOFILM FLIGHT RESULTS
Donald R. Williams *In* AFCRL Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 3-6 (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

An overall success rate of 88.6 percent is reported for 114 StratoFilm balloons, and the 13 failures are discussed. The principal problems are due to damage inflicted during ground-handling of balloons made from the thinner gauge films currently being used. Flight records for large balloons at Churchill and Palestine indicate that StratoFilm may have higher radiation-absorption characteristics than regular polyethylene. Author

N66-35349# Air Force Cambridge Research Labs., Bedford, Mass.
BALLOON RECOVERY SYSTEMS
James C. Payne *In its* Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p. 25-30 (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

The increased reliability of the scrim reinforced plastic balloon is offset by its higher costs. To reduce the per flight cost, two systems are being developed to recover balloons after mission completion, so that they can be reused. One system is used where tandem balloons are employed, the other system is designed to be used with the standard single balloon. Author

N66-35350# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
ON CREEP FAILURE OF BALLOONS
Arnold D. Kerr *In* AFCRL Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 31-47 refs (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

Assuming that the balloon material responds like a Maxwell model, it is demonstrated that there exists a critical time at which the balloon will rupture. The characteristic features of this phenomenon are demonstrated on a spherical balloon which is subjected to a constant internal pressure, with no restrictions imposed upon the magnitude of the balloon displacements. Planned investigations to correlate these phenomena of creep failure with recent balloon failures are outlined. Author

N66-35351# Air Force Cambridge Research Lab., Bedford, Mass.
SOME POLYETHYLENE BALLOON STATISTICS
James F. Dwyer *In its* Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 49-58 (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

Some pertinent details of the balloon-data-sorting program are presented together with general descriptions of the balloons studied. The cross section of designs and the quantities thereof, though not extremely large, represent probably the best study sample taken to date. Fairly conclusive evidence is presented that environmental temperatures at or below the cold brittle transition temperature of polyethylene are not sufficient to produce balloon burst. Finally, it is shown that ambient launch temperature appears to be a critical factor both statistically and from an engineering viewpoint. Author

N66-35352# National Center for Atmospheric Research, Boulder, Colo.
BALLOON PERFORMANCE ANALYSIS—NCAR SCIENTIFIC BALLOON FACILITY
Thomas W. Bilhorn *In* AFCRL Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 59–63 (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

Flight history of NCAR-conducted flights are presented. Correlation of balloon vehicle performance versus size, material gauge and manufacture, free lift, gross load, ground conditions, etc., are presented. In addition, a thesis is presented which states that ascent failures best correlate with low temperatures and amount of excess material at the base of the balloon bubble. Author

N66-35353# Schjeldahl (G. T.) Co., Northfield, Minn.
TANDEM BALLOON SYSTEMS
Richard D. Moroney *In* AFCRL Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 65–75 (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

Mission requirements such as low-shock launch, very large heavy-weight payloads, and very large and fragile balloon systems have required development of new launch methods. The tandem balloon system appears to offer the greatest overall advantages with regard to system capability and reliability and balloon recovery. The advantages of this system and areas that require further development are presented. Author

N66-35354# Air Force Cambridge Research Labs., Bedford, Mass.
AFCRL TETHERED-BALLOON PROGRAMS
William R. Ferguson *In its* Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 77–95 refs (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

A summary of current AFCRL tethered balloon programs is presented. Tethered balloon configurations, test instrumentation, and associated equipment, including experimental cables, are discussed. AFCRL planned programs which are intended to increase the state-of-the-art are summarized as are the potential applications for these systems. Author

N66-35356# Raven Industries, Inc., Sioux Falls, S. Dak.
FLIGHT EXPERIENCE WITH BALLOONS HAVING MEANS OF STRESS CONTROL IN THE BUBBLE
J. A. Winker *In* AFCRL Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 103–117 (See N66-35346 21-02)

In the recent past a concentrated effort was made to derive solutions to the problem of mid-altitude balloon bursts. Since only a small bubble of the balloon is involved at the time of failure, many of the solutions aim at modifying the stresses in the bubble region alone. Several of the approaches were tried in actual flights and the results are reported. Author

N66-35365# Lockheed-Georgia Co., Marietta.
XV-4A VTOL RESEARCH AIRCRAFT PROGRAM Summary Report, 30 Jun. 1961–30 Sep. 1965
Robert Nicholson and Randall B. Lowry Ft. Eustis, Va., Army Aviation Mater. Lab., May 1966 123 p refs
(Contracts DA-44-177-TC-773; DA-44-177-AMC-14(T))
(USAAVLABS-TR-66-45; AD-635106) CFSTI: HC $4.00/MF $1.00

A program was conducted to determine the feasibility of the augmented jet ejector concept for attaining a VTOL capability for aircraft. During the flight test program, the actual vertical thrust realized was only about 93 percent of that predicted, and consequently the aircraft, the SV-4A, had a marginal lift capability. This marginal lift capability severely limited the capability to conduct quantitative data gathering during the flight test program. The report presents the limited quantitative results obtained and a brief summary of the aircraft design, systems, flight test program, VTOL lift improvement program, and small-scale and full-scale wind tunnel programs. The feasibility of the augmented jet ejector concept was demonstrated; however, this concept is not considered to be competitive with other concepts for attaining a VTOL capability. Author (TAB)

N66-35366# American Helicopter Society, Inc., New York.
PROCEEDINGS OF 1st NATIONAL V/STOL AIRCRAFT SYMPOSIUM, SUPPLEMENT
[1965] 24 p refs Conf. held at Wright-Patterson AFB, Ohio, 3–4 Nov. 1965 CFSTI: HC $4.00/MF $1.00
(AD-634548)

CONTENTS:

1. X22A FLIGHT TEST PROGRAM R. L. Pfeiff (Bell Aerosystems Co.) p 1–24 refs (See N66-35367 21-02)
2. LIFT FAN V/STOL E. F. Beeler (GE) p 24A–66 refs (See N66-35368 21-02)
3. THE BREGUET 941/MCDONNELL 188 CROSS-SHAFT SYSTEM H. J. de Garcia, Jr. p 67–94 refs (See N66-35369 21-02)

N66-35367# Bell Aerosystems Co., Buffalo, N. Y. Flight Test and Operations Section.
X-22A FLIGHT TEST PROGRAM
Robert L. Pfeiff *In* Am. Helicopter Soc. Proc. of 1st Natl. V/STOL Aircraft Symp., Suppl. [1965] p 1–24 refs (See N66-35366 21-02) CFSTI: HC $4.00/MF $1.00

A description of the X-22A airplane and its systems is given including the special testing undertaken to prove these systems. Test progress and certain problem areas related to VTOL design are discussed. Test pilot participation in the preflight phases of the program and pilot preparation for first flights is described. Progress in ground test buildup to first flight is reported. Approach to first flight and development of V/STOL profiles is covered and the demonstration program including military participation is outlined. Author

N66-35368# General Electric Co., Cincinnati, Ohio. Lift Fan Systems Operation.
LIFT FAN V/STOL
E. F. Beeler *In* Am. Helicopter Soc. Proc. of 1st Natl. V/STOL Aircraft Symp., Suppl. [1965] p 24A–66 refs (See N66-35366 21-02) CFSTI: HC $4.00/MF $1.00

The feasibility of the lift fan concept has been demonstrated with the XV-5A research aircraft. Both contractor and government pilots have evaluated the characteristics of fan powered flight and the compatibility of lift fans with high subsonic speed aircraft design, for which the lift fan concept appears to be particularly well suited. A second generation of development since 1963 and this has provided a current base from which engineering development can confidently proceed to satisfy military V/STOL requirements as they are defined. Author

N66-35369# McDonnell Aircraft Corp., St. Louis, Mo. Aircraft Engineering Div.
THE BREGUET 941/MCDONNELL 188 CROSS-SHAFT SYSTEM
H. J. de Garcia, Jr. *In* Am. Helicopter Soc. Proc. of 1st Natl. V/STOL Aircraft Symp., Suppl. [1965] p 67–94 refs (See N66-35366 21-02) CFSTI: HC $4.00/MF $1.00

The operational features of the Breguet 941 aircraft are described. Four 400 horsepower turbine engines power four propellers linked by a cross-shaft system. This interconnection was intended to avoid large roll and yaw asymmetry during an engine out condition, and to provide improved flying qualities

and operational characteristics during normal flight. The results of bench tests and flight experience indicated that the hypercritical cross-shaft system is a useful, trouble-free, minimum maintenance, lightweight system. It is stated that the concept of this mechanical interconnection can be applied to many other V/STOL designs, and shows promise for large reductions in complexity usually associated with shaft driven systems. H.S.W.

N66-35644# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
A STANDARD AIRCRAFT WEAPONS MANAGEMENT AND RELEASE CONTROL SYSTEM (SAWMARCS) DESIGN PROPOSAL FOR THE F-111B AIRCRAFT Final Report
R. H. Barnhart 1 Jun. 1966 21 p refs
(NADC-AE-6616; AD-634250) CFSTI: HC $1.00/MF $0.50

Some form of integrated weapons management system for Navy aircraft is feasible and essential to relieve the accumulating confusion and loss of reliability now occurring in Navy aircraft armament control systems. It is concluded that the well advanced stores management system being proposed by NAVAIRDEVCEN presents precedence setting solutions to many existing armament system problems. The general outline of a well advanced airborne stores management system describes a system for the F-111B that offers solutions to present and foreseeable future armament control system problems in the cockpit, in the avionics bay, on the flight deck, and in the maintenance system. The proposed NAVAIRDEVCEN SAWMARC system is an adequate solution for 1968 through 1970 Navy aircraft armament management system problems.
Author (TAB)

N66-35658*# Systems Technology, Inc., Hawthorne, Calif.
APPLICATION OF APPROACH SPEED CRITERIA DERIVED FROM CLOSED-LOOP PILOT-VEHICLE SYSTEMS ANALYSES TO AN OGEE WING AIRCRAFT
Richard J. Wasicko Washington, NASA, Sep. 1966 55 p refs (Contract NAS2-1868)
(NASA-CR-579) CFSTI: HC $2.50/MF $0.50 CSCL 01B

Minimum comfortable approach speed criteria for aircraft carrier and airfield VFR landings are established from closed-loop pilot-vehicle analyses. The results are applied to an F5D-1 airplane modified with an ogee shaped wing. Drag characteristics and static longitudinal stability are varied and their effects on the predicted approach speeds are determined. The analysis indicates that for most of the configurations the approach speeds should not differ greatly for the two types of approaches, with the largest difference occurring for a low drag, high static margin configuration. A reduction in zero-lift drag or an increase in static longitudinal stability has an adverse effect on the predicted approach speeds. Author

N66-35954*# National Aeronautics and Space Administration, Washington, D. C.
INSTABILITY CRITERIA IN THE STUDY OF MINIMIZING ROLLING AND PITCHING [CRITERE D'INSTABILITE DANS L'ETUDE DU COUPLAGE ROULIS-TANGAGE]
M. Mesnière Aug. 1966 12 p Transl. into ENGLISH of a Paper Presented at the AGARD Congr. on Stability and Flight Controls, Cambridge, England, 20-23 Sep. 1966 p 1-9
NASA-TT-F-10247) CFSTI: HC $1.00/MF $0.50 CSCL 01D

The 60°-sweep delta-wing Griffon aircraft was tested by analog computer to increase speed to Mach 2.5. Pitch coupling and stabilized values of roll rate were studied. Five nonlinear algebraic equations were used for slip, incidence, and angular rates of roll, pitch and yaw. Some use of digital computer was made. Stable and unstable movement are considered. Author

N66-36004# Tactair Fluid Controls Corp, Bridgeport, Pa.
DEVELOPMENT AND DEMONSTRATION OF A LIGHT AIRPLANE STABILITY AUGMENTATION SAFETY SYSTEM
James E. Gasho, Harry W. Johnson, and James D. Reyner, Jr. Feb. 1965 43 p refs
(Contract FA-WA-4512)
(ADS-10)

This report describes the development and demonstration of a light airplane stability augmentation safety system (SAS). When manually selected by the pilot, SAS provides stability augmentation adequate to preclude upsets due to pilot inattention or disorientation. If not manually selected, SAS warns the pilot when he is approaching hazardous flight regimes and automatically returns the airplane to normal flight speeds and attitudes. The cruise-relief function has received FAA certification. Author

N66-36027# David Taylor Model Basin, Washington, D. C.
SOME DESIGN PRINCIPLES OF GROUND EFFECT MACHINES. SECTION D: DRAG
Harvey R. Chaplin and Allen G. Ford Jun. 1966 31 p refs
(DTMB-2121-D; DTMB-AERO-1100-D; AD-636277) CFSTI: HC $2.00/MF $0.50

Six vehicle drag terms are derived. These apply to the sidewall captured air bubble air cushion vehicle and the full-peripheral air cushion vehicle. Author (TAB)

N66-36098*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
DESIGN METHODS FOR MINIMIZATION OF SONIC-BOOM PRESSURE-FIELD DISTRUBANCES
F. Edward Mc Lean and Barrett L. Shrout [1965] 23 p refs Presented at the 70th Meeting of the Acoust. Soc. of Am., St. Louis, 3-6 Nov. 1965
(NASA-TM-X-57028) CFSTI: HC $1.00/MF $0.50 CSCL 01C

This paper will review theoretically based techniques for minimization of sonic-boom pressure-field energy and overpressure through detailed consideration of airplane configuration. The discussion will include consideration of the recently discovered potential for overpressure minimization for large slender airplanes with extended near-field characteristics. Use of the latter method will be illustrated with correlations of theory and wind-tunnel measurements. Author

N66-36120*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
SONIC-BOOM CHARACTERISTICS OF PROPOSED SUPERSONIC AND HYPERSONIC AIRPLANES
F. Edward Mc Lean, Harry W. Carlson, and Lynn W. Hunton (NASA, Ames Res. Center) Washington, NASA, Sep. 1966 17 p refs Presented at the Conf. on Aircraft Aerodyn., Langley Sta., Va., 23-25 May 1966
(NASA-TN-D-3587) CFSTI: HC $1.00/MF $0.50 CSCL 01C

Existing theoretical methods of sonic-boom estimation have been used to determine the sonic-boom profiles of representative supersonic and hypersonic airplanes of the future. The sonic-boom characteristics of these future airplanes have been related to the sonic-boom characteristics of current supersonic airplanes. In the supersonic climb and cruise phases of flight, where the sonic-boom overpressure and impulse levels are relatively high, the use of near-field effects to modify the sonic-boom disturbance of these large future airplanes has been considered. The near-field investigation indicates that some reduction in overpressure and impulse might be possible. Author

N66-36247*# United Aircraft Corp., Norwalk, Conn. Norden Div.
A STUDY OF DISPLAY INTEGRATION FOR HYPERSONIC RESEARCH VEHICLES First Quarterly Progress Report, 16 May–16 Aug. 1963
C. F. Schaefer and Peter R. Williams 13 Sep. 1963 53 p refs *Its* Rept.-1141-R-0003A
(Contract NASw-675)
(NASA-CR-77937) CFSTI: HC $3.00/MF $0.50 CSCL 01C

Contact analog techniques are being investigated as a means of display integration for the X-15 hypersonic research vehicle. The basic contact analog display presents flight information in the form of a synthetic television picture corresponding to the real-world view from the cockpit. Results of preliminary studies of pilot control tasks and flight profiles for the X-15 are included and important flight parameters are analyzed with respect to total range of variation and rates of change for display design considerations. Basic requirements for an integrated display for this type of mission include a: wide dynamic range with good sensitivity, capability of displaying command information, high accuracy, and flexibility of operation. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-35459# Naval Weapons Lab., Dahlgren, Va. Warhead and Terminal Ballistics Lab.
AN INVESTIGATION OF THE EFFECTS OF HYDROSTATIC PRESSURE ON CARTRIDGE ACTUATED DEVICES
T. J. Nock Jun. 1966 30 p refs
(T-8/66; AD-635211) CFSTI: HC $1.50/MF $0.50

The effect of hydrostatic pressure on the operation of cartridge actuated devices in the hydrosphere is explored by means of an analytical model and a numerical example computed by the model. The analog computer program for the example is included. The study indicates that hydrostatic pressure may set the limiting depth to which devices of the type considered can perform useful work in the hydrosphere. The need for further work is indicated in the area of the effects of hydrodynamic drag. The model should be verified by actual underwater tests. Author (TAB)

N66-35466# Franklin Inst., Philadelphia, Pa. Research Labs.
DYNAMIC PERFORMANCE ANALYSIS OF PURE FLUID AMPLIFIERS AND PURE FLUID COMPUTATIONAL CIRCUIT STUDIES Final Report, Sep. 1963–Sep. 1965
Ka-cheung Tsui and John Stone [1965] 122 p refs
(Contract DA-49-186-AMC-95(D))
(F-B2148-1; AD-634527) CFSTI: HC $4.00/MF $0.75

CONTENTS:

1. PART I: STUDIES ON THE DYNAMIC PERFORMANCE OF PROPORTIONAL PURE FLUID AMPLIFIERS p 1–62 refs (See N66-35467 21-03)
2. PART II: PURE FLUID ANALOG COMPUTATIONAL CIRCUIT STUDIES W. C. Reisener, Jr. p 63–105 refs (See N66-35468 21-03)

N66-35467# Franklin Inst., Philadelphia, Pa. Research Labs.
STUDIES ON THE DYNAMIC PERFORMANCE OF PROPORTIONAL PURE FLUID AMPLIFIERS
In its Dyn. Performance Analysis of Pure Fluid Amplifiers and Pure Fluid Computational Circuit Studies [1965] p 1–62 refs (See N66-35466 21-03) CFSTI: HC $4.00/MF $0.75

An analysis is presented for fluid amplifier dynamic behavior, the derivation of its transfer function, the calculation of expected frequency response, and its correlation with actual performance. A dynamic equivalent circuit developed to derive the amplifier transfer function is described. A direct measure of output impedance of a particular amplifier is made to confirm the validity of the output resistance obtained from the static characteristics. Results establish the validity of new application techniques for applying fluid amplifiers in feedback control systems. A method for measuring the fluid amplifier transfer function by use of an electronic analog computer operated in conjunction with the fluid amplifier is devised and analyzed. The method utilizes a closed-loop simulation of the predicted amplifier transfer function in an analog computer in series with the test fluid amplifier through the pressure transducer. S.P.

N66-35468# Franklin Inst., Philadelphia, Pa. Research Labs.
PURE FLUID ANALOG COMPUTATIONAL CIRCUIT STUDIES
William C. Reisener, Jr. *In its* Dyn. Performance Analysis of Pure Fluid Amplifiers and Pure Fluid Computational Circuit Studies [1965] p 63–105 refs (See N66-35466 21-03) CFSTI: HC $4.00/MF $0.75

A pure fluid integrator using a beam deflection type proportional amplifier with positive feedback as the active circuit element is developed and discussed. An equivalent circuit analysis and experiments are described to show the time integration characteristics of the preliminary design experimental model. This positive feedback pure fluid integrator is proved by mathematical derivation and by experiment to have an output pressure which is a true time integral of the input pressure within limitations of the circuit element at the specified operating condition. S.P.

N66-35823# Genistron, Inc., Los Angeles, Calif.
DEVELOPMENT AND EVALUATION OF 60 CYCLE AND 400 CYCLE TRANSFORMER-FILTERS Final Report
Walter K. Grossmann Port Hueneme, Calif., Naval Civil Eng. Lab., 6 May 1966 60 p
(Contract NBy-62194)
(CR-66.006; AD-635487) CFSTI: HC $3.00/MF $0.75

This report contains final design and performance data of the Genistron BP-814 and BP-815 transformer filters. The report also compares theoretical findings with the measured performance of the filters by means of graphical presentation of essential parameters. A discussion of these results permits selection of an optimum trade-off between parameters for future designs. Finally, a qualitative assessment of features, with regard to anticipated usage, is formulated as a general description and compared with established devices of similar performance. Author (TAB)

N66-35880*# TRW Equipment Labs., Cleveland, Ohio.
BIPROPELLANT PULSED ENERGY TURBOALTERNATOR POWER SYSTEM DEVELOPMENT Final Report, Sep. 1, 1965–Jul. 14, 1966
Aug. 1966 191 p refs
(Contract NAS9-4820)
(NASA-CR-65489; ER-6917) CFSTI: HC $3.25/MF $1.75 CSCL 10B

A turboalternator, gas generator and associated controls were designed. Three turboalternator units, four gas gen-

erators and one controls unit were fabricated. Turboalternator Unit #1 was tested for the purpose of system and facility integration. After preliminary tests, endurance tests were conducted on Unit #1. Power output, propellant consumption, coast times, and critical temperatures were obtained from the endurance tests. System performance was analyzed at various power levels and at two oxidizer/fuel (O/F) ratios. Analysis indicated an SPC of 11.9 lb/KW-HR at an equivalent electrical load of 3 KW at the DC terminals and an SPC of 11.1 lb/KW-HR at 4.5 KW at the DC terminals. In two instances while testing Unit No. 1, laboratory scavenge pump stoppages resulted in overloading the alternator and bearings with oil. Operation at 35 to 40 shaft H.P. for 4 to 5 secs. occurred before shut down. Pulses occurred each second during this period with no damage to the unit. At other times operation with partial oil starvation for short periods resulted in no bearing or seal failures. In the early development tests, altitude chamber temperatures up to 500°F were encountered with resultant Moog valve seat damage. Author

N66-35688# Royal Aircraft Establishment, Farnborough (England).

FIELD TESTS ON UK3 SOLAR CELL ASSEMBLIES

F. C. Treble Apr. 1966 38 p refs

(RAE-TR-66112) CFSTI: HC $2.00/MF $0.50

Tests were carried out on experimental cell assemblies to develop techniques for predicting orbital performance and to demonstrate the effects of shadows and typical faults. Performance curves of solar cell modules and panels taken in uncollimated sunlight, using a standard cell for insolation measurement, are presented and a method for extrapolating to air mass zero described. Typical shadow and fault effects are illustrated. Simple methods are described for calculating the effect of any shadow on the current generated by a solar cell array and for locating faults. Author

N66-35689*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

9.5-FOOT PARABOLOIDAL MASTER AND CONCENTRATOR Final Report

30 Jun. 1966 211 p refs *Its* Doc.-66SD4391

(Contract NAS1-4105)

(NASA-CR-66122) CFSTI: HC $6.00/MF $1.25 CSCL 10B

The fabrication of a 9.5 foot mirror master which would be of sufficient quality and durability for the reproduction of lightweight, high quality paraboloidal solar concentrators with the design objective of collector absorber efficiency of 75 percent of a 2000°K black body cavity is reported. An epoxy spincasting was produced which had an adjusted slope error of less than 35 arc seconds. On this concave surface a 3/8 inch thick nickel master was electroformed which yielded a slope error of approximately 3 minutes. A 9.5 foot nickel solar concentrator was then electroformed against the surface of the master. A nickel torus support ring was bonded to a transition cove ring located on the back of the mirror, after which the entire unit was successfully separated from the master. The various steps in the spincasting and electroforming processes are discussed, as well as investigations into separation of mirror surfaces from masters using vacuum techniques and the improvement of nickel surfaces using Kanigen coatings. These investigations were conducted using a 30 inch nickel master and electroforming an aluminum mirror against the experimental surface. Author

N66-35764# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE TRANSIENT CONDITIONS BY ELECTRIC-POWER SYSTEMS BY MEANS OF COMPUTERS

A. I. Vinogradova, Ye. G. Mikhailova, and N. K. Shuvalov 22 Aug. 1966 21 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 3, Mar. 1966 p 40-45

(JPRS-37150; TT-66-33579) CFSTI: $1.00

The basic characteristics of analog and digital computers are listed, and the capabilities of these computers are considered from the viewpoint of solving problems encountered in designing shipboard electric power systems (EES). The advantages and disadvantages of each are compared, with emphasis placed on the feasibility of using the digital computer due to the marked increase of the order of differential equations describing the EES processes. An example is given for calculating the transient conditions in a synchronous turbogenerator with self-excitation, with the switching of the load from 20% to 10%. It was concluded that the most successful results are obtained by simultaneous use of both computers, with the analog computer used for first stage investigations, and the digital computer for a more accurate calculation of the wide variation in parameters. M.G.J.

N66-35884# Babcock and Wilcox Co., Barberton, Ohio. Boiler Div.

SODIUM-HEATED STEAM GENERATOR DEVELOPMENT Quarterly Progress Report, Jan.-Mar. 1966

P. B. Probert 8 Apr. 1966 32 p

(Contract AT(11-1)-1280)

(BAW-128036) CFSTI: HC $2.00/MF $0.50

The Preliminary Design of the Prototype Steam Generator was completed. Fabrication of the Prototype Steam Generator is approximately 35% complete and on schedule. The present status of the several research and development projects still underway is outlined. Author (NSA)

N66-35890# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

THE INTERNAL POTENTIAL DROP IN MHD GENERATORS [DER INNERE POTENTIALABFALL IN MHD-GENERATOREN]

M. Salvat Apr. 1966 14 p In GERMAN; ENGLISH summary

(IPP-3/38)

The finite length of the electrodes in MHD generators perturbs the potential distribution corresponding to an ideal case (i.e., to infinitely segmented electrodes). Hence the potential drop between the electrodes and thus the internal resistance of the generator increase. It is shown by means of simple physical arguments that the change of the potential drop and the corresponding increase of the internal resistance are expressible in the form

$$\frac{\Delta\phi i^*}{\Delta\phi^*} = \frac{Ri}{R} = \frac{1}{A+\beta D}$$

where $\Delta\phi^*$ and R are the potential drop and the internal resistance, respectively; the subscript "i" denotes the "ideal" case, $\beta = \omega\tau$ is the Hall coefficient, A and D are two parameters which, as is shown are defined by the geometry and the relative position of the electrodes. Author (NSA)

N66-35891# Dynatech Corp., Cambridge, Mass.

INVESTIGATION OF BOILING FLOW REGIMES AND CRITICAL HEAT FLUX Quarterly Progress Report, 16 Sep.-15 Dec. 1965

A. E. Bergles, L. G. Clawson, J. P. Roos, and J. G. Bourne 1 Feb. 1966 23 p refs *Its* Rept.-625

(Contract AT(30-1)-3304)

(NYO-3304-7) CFSTI: HC $1.00/MF $0.50

The design details of the steam loop were completed and major components are being procured. The operating characteristics of the steam loop are discussed. Preliminary tests were made with an electrical probe which measures the characteristics of the annular liquid film. The data indicate

that the mean film thickness decreases with increased steam quality and increased total flow rate. In addition, the liquid film disappears as the critical condition is approached. The operational checkout of the traversing isokinetic sampling probe was completed. The results for centerline sampling of adiabatic single-phase flow are in good agreement with generalized velocity profile data. Only a few of the two-phase sampling data points can be considered correct due to leaks which developed after extended periods of operation. The film probe and the sampling probe have indicated that the high quality flow pattern is characterized by an annular liquid film and a core with entrained liquid, thereby establishing that this flow pattern is spray annular. Author (NSA)

N66-35946*# Philco Corp., Palo Alto, Calif. WDL Div.
EXPERIMENTAL STUDY OF COATINGS FOR TEMPERATURE CONTROL OF SOLAR CELLS
Donald C. Briggs 6 Jun. 1966 172 p refs
(Contract NAS7-409)
(NASA-CR-73030; WDL-TR-2949) CFSTI: HC $3.25/MF $1.25 CSCL 10A

An analytical and experimental program was undertaken to study the use of selective interference filters and highly reflective coatings for temperature control of solar cells. Optical characteristics of reduced bandpass filters and metallic reflective coatings as a function of angle of incidence and temperature were measured and presented. Experimental efforts included the measurement of filter-adhesive-cell composite performance under equilibrium temperature conditions at insolation levels approximately equal to those encountered at 1.0, 0.6, and 0.4 AU. These tests were performed on a model simulating a spinning spacecraft. In addition, analytical studies were performed to determine the optimum assembly using filters and/or reflective metallic coatings and to predict solar cell temperature and performance at 1.0, 0.6, and 0.4 AU. The analysis was also conducted for the case of spinning spacecraft with solar cells bonded to, but thermally insulated from, the spacecraft. Author

N66-35973*# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
MIXED-FEED METHANOL-OXYGEN FUEL CELLS
Stephen R. Schulze (Ph.D. Thesis) Aug. 1966 238 p refs
(Grant NsG-496)
(NASA-CR-77760) CFSTI: HC $3.75/MF $1.50 CSCL 10A

Mixed-feed fuel cells are fed with a single stream containing fuel, oxidant, and electrolyte. Since both fuel and oxidant come into contact with each electrode, the performance of such a cell depends upon how successfully the fuel reacts selectively at the anode, and the oxidant at the cathode. The mixed-feed performance and selectivity of several electrodes, with methanol and oxygen as reactants, was studied for mixed-feed electrode behavior, and to determine the practicality of a cell of this type. Silver metal was found to be a perfectly selective oxygen cathode: Methanol did not react at the silver cathode. However, platinum anodes did not perform in such an ideal manner. A porous diffusion type platinum electrode was very inefficient. A platinum metal gauze electrode used in conjunction with a silver cathode had a fuel utilization efficiency of 95%. The mixed-feed current output of the platinum electrodes could be quantitatively related to the polarization curves for the single reactants. The non-current-producing reaction was found to occur by both a catalytic and electrochemical mechanism. Author

N66-36024# Politecnico di Torino (Italy). Istituto di Macchine e Motori per Aeromobili.
EXPERIMENTAL RESEARCH ON ELECTROTHERMIC ARC POWER UNITS OPERATING IN THE SURROUNDING AIR [RICERCHE SPERIMENTALI SU PROPULSORI ELETTROTERMICI AD ARCO OPERANTI IN ARIA AMBIENTE]
A. Robotti and M. Oggero Oct. 1965 31 p refs In ITALIAN
Sponsored by the Consiglio Nazl. delle Ric.
(Publ.-50) CFSTI: HC $2.00/MF $0.50

Experimental results are presented for research dealing with an electrothermally driven arc operating at ambient atmospheres. The program was conducted between 1961 and 1965 at the Aerospace Engineering School of the Politechnico di Torino. The prototype equipment is described, and operational gains with different gas propellants are discussed. Numerous graphs and illustrations are included. Transl. by M.W.R.

N66-36080*# Naval Ammunition Depot, Crane, Ind.
LIFE CYCLE TESTS Monthly Progress Report, 1-31 Aug. 1965
[1965] 148 p
(NASA Order W-11252-B)
(NASA-CR-77885) CFSTI: HC $4.00/MF $1.00 CSCL 10C

The results of life cycle tests conducted during this period on 5 and 10 cell packs of nickel-cadmium cells, 5 and 10 cell packs of silver–zinc cells, and 10 cell packs of silver–cadmium cells are tabulated. The data sheets show the end of discharge and end of charge voltage readings for each cell on each cycle recorded. Data from capacity tests of each pack are also included. R.N.A.

N66-36101*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
APPLICATION OF GALLIUM-ARSENIDE SOLAR CELLS TO SOLAR PROBE POWER SYSTEMS
1 Feb. 1966 88 p refs Reissued
(Contract NAS2-2600)
(NASA-CR-69537; AED-R-2817-1) CFSTI: HC $3.00/MF $0.75 CSCL 10A

The study was undertaken to establish the power system applications of gallium–arsenide solar cells for solar probe missions. Results indicate that, with the use of suitable temperature-control techniques, gallium–arsenide solar cells will be a practical source for missions with solar approach distances down to 0.07 AU. Closer approaches will be feasible only if area, weight, or cost can be increased beyond those limits which presently appear practical. As solar cell temperature tends to rise with decreasing perihelion, an important part of the effort involved conceptual design of reliable, lightweight, temperature control systems. For each temperature control technique considered, three different types of solar array designs were developed, to independently minimize weight, area, and cost per unit of power. Selected temperature control techniques were considered to correlate system design with distance from the Sun, establishing practical limits for the minimum perihelion. All findings are based upon practical weight, area, and cost considerations for each of the four solar-probe trajectories. Author

N66-36109*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

THERMAL INTEGRATION OF ELECTRIC POWER AND LIFE SUPPORT SYSTEMS FOR MANNED SPACE STATIONS

R. W. Woods and E. P. Erlanson Washington, NASA, Sep. 1966 323 p refs

(Contract NAS3-6478)

(NASA-CR-543) CFSTI: HC $4.25/MF $1.75 CSCL 10B

Rankine and Brayton Cycle electric power systems using isotopic and Solar Sources are analyzed and thermally integrated with attitude control, refrigeration, life support and cabin environmental control systems. The resulting system design with the most potential for use with a six-man orbiting station is a combined life support–solar Brayton system weighing 3593 pounds. The electrical power requirements were reduced from eight kilowatts for a non-integrated system to five kilowatts for an integrated system with the use of power system waste thermal energy. The two-man lunar shelter considered had an integrated electrical power reduction of 1.2 kilowatts. Author

N66-36355# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).

STUDY OF THE POLARIZATION OF DSK PALLADIUM—HYDROGEN ANODES FOR FUEL CELLS [UNTERSUCHUNGEN DER POLARISATION VON DSK-PALLADIUM-WASSERSTOFFANODEN FUR BRENNSTOFFZELLEN]

W. Rasch Feb. 1966 50 p refs In GERMAN; ENGLISH summary

(DLR-FB-66-17) CFSTI: HC $2.00/MF $0.50

A hydrogen electrode useful for acid solutions is described, which is based on palladium and silver according to the DSK-principle. To optimize the electrodes the kinetic of the reaction was investigated by stationary dc-measurement and during galvanostatic switch-on phase. It became apparent, that the diffusion of the reaction product is retarded in that part of the porous electrodes, which is filled with the electrolyte, and causes limiting current-density in the alkaline and corrosion of the metal in the acid medium. The electrochemical measurements and the examination of the porosity of the electrodes has confirmed the assumed model of the active layer of the electrodes. Author

N66-36372*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.

PROGRAM TO DEVELOP AN INORGANIC SEPARATOR FOR A HIGH TEMPERATURE SILVER-ZINC BATTERY

Quarterly Progress Report, 29 Apr.-29 Jul. 1966

C. Berger, F. C. Arrance, and A. Himy Jul. 1966 33 p refs

(Contract NAS3-7639)

(NASA-CR-72062; SM-48461-Q4) CFSTI: HC $2.00/MF $0.50 CSCL 10C

A 5 Ah cell was designed using a frame concept to compartmentalize the electrodes. The design has 5 silver and 4 zinc electrodes and has proven adequate for the cells under investigation. Long cycle life capability of cell components was demonstrated and up to 3123 cycles were achieved. Full 5 Ah multiple plate cells were cycled 1465 times at 25°C. Multiple plate 5 Ah cells achieved 140 cycles at 100°C. Test cells were satisfactorily operated in various orientations and no significant difference was observed in cells operating on their side or inverted as compared to normal upright operation. Armalon felt appears to be a satisfactory top closure material. Test cells using a rigid frame sealant declined in capacity after high temperature testing and did not have nominal OCV (1.86 v). Cells using a flexible sealant had less change after heating to 135°C for 3 hours. R.N.A.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-35372# Joint Publications Research Service, Washington, D. C.

***VESTNIK* OF THE USSR ACADEMY OF MEDICAL SCIENCES, VOLUME XXI, NO. 5, 1966**

9 Aug. 1966 112 p refs Transl. into ENGLISH from Vestn. Akad. Med. Nauk SSSR (Moscow), v. 21, no. 5, 1966 p 3-95 (JPRS-36915; TT-66-33345) CFSTI: $4.00

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N66-35373# Joint Publications Research Service, Washington, D. C.

RESULTS OF EXPERIMENTAL TREATMENT OF RADIATION ILLNESS

P. D. Gorizontov and V. D. Rogozkin *In its* Vestn. of the USSR Acad. of Med. Sci., Vol. 21, No. 5, 1966 9 Aug. 1966 p 10–22 refs (See N66-35372 21-09) CFSTI: $4.00

The article carries experimental materials about the effectiveness and mode of action proper to agents of chemical and biological protection, remedial preparations and patterns of complex therapy in diverse types of radiation injuries. The most effective chemical protective preparations are shown to alleviate the action of radiation upon hemopoietic organs, while in the mechanism underlying the activity of agents of biological protection account should be taken of their ability to raise the non-specific resistance and of changes which meanwhile take place in the functional state of the blood formation. As established, the most effective method of therapy in radiation sickness is not so much the use of individual curative agents, but that of pathogenic complex treatment patterns. These complexes should include as basic therapeutic means antibiotics, hemopoietic stimulators, antihemorrhagic agents, desensibilizing and detoxicating preparations, hormones and vitamins. Author

N66-35374# Joint Publications Research Service, Washington, D. C.

PRELIMINARY DATA ON THE POSSIBLE ROLE OF CONNECTIVE TISSUE IN ACHIEVING DEEP HYPOTHERMIA

A. Labori, B. Veber, Ts. Shekler, and Ts. Baron *In its* Vestn. of the USSR Acad. of Med. Sci., Vol. 2, No. 5, 1966 9 Aug. 1966 p 73–83 refs (See N66-35372 21-04) CFSTI: $4.00

Introduction of neuroplegic substances first, followed by sodium 4-hydroxybutyrate allows the obtaining of hypothermia in dogs within the limits of 18–20°, with final survival of the animals involving no application of extracorporeal circulation or artificial respiration machines. The desoxycorticosterone pre-treatment brought about an appreciable letality among the animals subjected to hypothermia, but in this case the apparent modifications, as it seems, should be attributed to the technique itself. Administration of potassium, which has to be practiced in control animals at the outset of hypothermia in these particular conditions seems to be inadvisable. In this aspect other cases must be studied. Author

N66-35376# Naval Submarine Medical Center, Groton, Conn. Research Lab.

VERTIGO AMONG DIVERS Interim Report

Lewis Terry and W. Landon Dennison 6 Apr. 1966 11 p refs (Rept.-66-2; AD-635518) CFSTI: HC $1.00/MF $0.50

Vertigo is a common symptom among divers, although its incidence has not heretofore been given the consideration it may deserve. The authors feel that the incidence of this symptom among divers is in consonance with the experience of the diver, that is, many divers will experience vertigo if they dive long enough. Vertigo must be recognized and differentiated from the more severe forms of dysbarism, particularly when it manifests itself by a loss of balance, nausea, and unconsciousness. Both pressure changes within the middle ear and caloric stimulation may play an important role in the development of vertigo among divers. Inequality of the caloric stimulation (between the right and left ear) appears to play only a minor role. The important factor seems to be the movement of endolymph, whether by eddy currents from movements of the stapes or convection current caused by caloric stimulation. Author (TAB)

N66-35384# School of Aerospace Medicine, Brooks AFB, Tex.

WHOLE SALIVA PROTEASE LEVELS IN RELATION TO PERIODONTAL STATUS IN MAN Final Report, Jun. 1962–Dec. 1963

Howard H. Chauncey (Tufts U., Boston) and Ira L. Shannon Apr. 1966 12 p refs

(SAM-TR-66-35; AD-635112) CFSTI: HC $1.00/MF $0.50

Whole saliva protease activity was measured in 83 randomly chosen subjects and in 59 persons with severe periodontal involvement. Thirty-three persons from the latter group were retested at least 3 months after periodontal surgery. Significant differences were found between these subject groupings, protease levels being high in subjects with periodontal disease and decreasing after therapy. Parotid and submaxillary fluids demonstrated no protease activity. The proteolytic enzymes present in whole saliva were observed to originate from both mammalian cellular elements and microorganisms. Author (TAB)

N66-35542# Naval Submarine Medical Center, Groton, Conn.

OXYGEN BREATHING EFFECTS UPON NIGHT VISION THRESHOLDS Interim Report

Paul R. Kent 2 Feb. 1966 19 p refs

(Rept.-469; AD-634798) CFSTI: HC $2.00/MF $0.50

Two series of experiments were conducted; one was concerned with the effects of mask breathing, and the other with breathing 100% oxygen at ambient (sea level) pressure. It was found that the effect of oxygen excess upon rod and cone scotopic threshold is subject to individual variation. Rod and cone scotopic thresholds are only exceptionally affected by breathing near-100% oxygen for periods up to 140 minutes. When administered at higher pressure, even for periods as short as 20 minutes, the incidence of effects is sharply higher. Rod and cone scotopic thresholds, measured while breathing near 100% oxygen are sensitive to blood sugar levels. Breathing through a mask-demand valve system of the type used in these experiments may cause an elevation of the rod and/or cone scotopic threshold(s) of some individuals, apart from any effect of the inhalant. Author (TAB)

N66-35564# Battelle Memorial Inst., Columbus, Ohio.

EFFECTS OF RADIATION ON THE SUBMICROSCOPIC STRUCTURE OF THE SYMPATHETIC NEURON Final Report, 16 Mar. 1962–15 Jul. 1964

Richard M. Roppel, Carl W. Melton, Arthur C. Peters, Wayne H. Allton, and John E. Prince Brooks AFB, Tex., School of Aerospace Med., Apr. 1966 17 p refs

(Contract AF 41(609)-1585)

(SAM-TR-66-32; AD-634405) CFSTI: HC $1.00/MF $0.50

Hamsters were irradiated with supralethal, single doses and with sublethal, fractionated doses of Co^{60} gamma radiation. Autonomic ganglia were dissected from these animals at various times after irradiation and were studied by electron microscopy for evidence of morphologic change resulting from irradiation. When fixation was accomplished by direct immersion of tissues in permanganate solution, only minimal cellular changes that could be attributed to radiation were observed in sympathetic tissues following single massive doses of 10,000 to 100,000 R. When perfusion fixation was attempted, however, extensive fixation artifact was observed in the tissues of irradiated animals but not in controls. Fractionated-dose irradiation to a total of 500 R administered as ten 50 R doses resulted in an increase in the number of densely straining, cytoplasmic inclusion bodies observed in sympathetic neurons. A permanganate-sodium plumbate staining procedure which results in an electron microscope image of high contrast is described. Author (TAB)

N66-35608# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

MANUAL OF RADIATION DOSIMETRY EXPERIMENTS

Kent C. Humpherys, ed. Bethesda, Md., Armed Forces Radiobiology Res. Inst., Nov. 1965 230 p refs

(Contract DA-49-146-XZ-226)

(EG&G-S-305-MN; AFRRI-CR65-4; AD-631318) CFSTI: HC $6.00/MF $1.25

Experimental procedures covering the general field of radiobiological dosimetry techniques and dosimetric systems, used in support of reactor operations and radiobiological research studies, are presented. The experiments are intended as a self taught course for technical personnel who have little or no knowledge of dosimetry techniques. Each experiment contains a theoretical discussion, detailed experimental procedures, suggestions for the concluding discussion, and a list of equipment. For more specific information concerning the individual experiments, see N66-35609–N66-35618. N.E.N.

N66-35609# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

EXPERIMENTAL CAVITY IONIZATION

A. C. Lucas *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 9–24 refs (See N66-35608 21-04) CFSTI: HC $6.00/MF $1.25

The determination of absorbed dose using an ionization chamber is investigated. The theoretical treatments of Bragg–Gray and Spencer–Attix are tested by varying the atomic number of both wall material and gas, and by varying gas pressure. The two theories are briefly reviewed. For general information, see N66-35608. N.E.N.

N66-35610# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

TISSUE EQUIVALENT IONIZATION CHAMBERS

R. L. Lynn *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 25–38 refs (See N66-35608 21-04) CFSTI: HC $6.00/MF $1.25

The calibrations of a 50 cc tissue equivalent ionization chamber and of a 50 cc graphite ionization chamber with Co^{60} and PuBe sources are studied. The neutron and gamma tissue dose components of a mixed radiation field are measured. The ionizing radiations affecting biological tissue are described. For general information, see N66-35608. N.E.N.

N66-35613# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

MEASUREMENT OF FAST NEUTRON TISSUE DOSE WITH THE HURST PROPORTIONAL COUNTER

J. A. Sayeg *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 97–116 refs (See N66-35608 21-04) CFSTI: HC $6.00/MF $1.25

A proportional counter is used to measure the absorbed dose in tissue due to fast neutrons while discriminating against gamma radiation. The data recording system is calibrated with an alpha source and a Pu–Be neutron source. The fast neutron dose is measured with a reactor steady state exposure. For general information, see N66-35608. N.E.N.

N66-35617# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

MEASUREMENT OF DEPTH DOSE

V. A. Sayeg *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 165–181 refs (See N66-35608 21-04) CFSTI: HC $6.00/MF $1.25

Depth dose measurements are made in tissue equivalent phantoms using tissue equivalent ionization chambers. An X-ray machine is used as a radiation source. The dose pattern throughout the phantom in relation to the entrance and exit dose is determined. Typical graphs of depth dose relation and distributions are included. For general information, see N66-35608. N.E.N.

N66-35624# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.

PHYSIOLOGICAL OBSERVATIONS ON SUBARCTIC BEARS UNDER WINTER DEN CONDITIONS

C. Edgar Folk, Jr., Richard C. Simmonds, and Mary A. Folk Mar. 1966 19 p refs

(AAL-TR-65-15; AD-635342) CFSTI: HC $3.00/MF $0.50

Heart rates, body temperature, and urinary output were studied in a variety of activity states in one or all of a group of four bears (two grizzly bears, Ursus horribilis, and two black bears, Ursus americanus Pallas). In addition, the cardiac activity of three black bears was studied during whole body hypothermia. The resting heart rates obtained during winter dormancy from three bears were significantly lower (75–91%) than those obtained during the summer. The physiological activity cycle of the dormant bears did not change appreciably as they continued to show a relatively high heart rate (40 beats/minute) in the morning hours. Body temperatures obtained from one black bear during winter dormancy showed only a 4°C depression. One dormant bear did not urinate for at least three months, and it was not until the third day post-arousal that voiding occurred. The three black bears subjected to whole body hypothermia experienced asystole and cardiac arrest at body temperatures of 16–21°C. At the time of cardiac arrest, heart rates as low as 1 beat/minute were recorded, indicating that bears could maintain low hypothermic heart rates.

Author (TAB)

N66-35696# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

PLASMA VOLUME AND GLOBULAR MASS DETERMINED WITH SERUM ALBUMIN WITH I-131 AND WITH RED GLOBULES LABELED WITH Cr-51 [VOLUMEN PLASMATICO Y MASA GLOBULAR DETERMINADOS CON SEROALBUMINA CON I-131 Y CON GLOBULOS ROJOS MARCADOS CON Cr-51]

Guillermo Rey, Alfredo Macchi, and Osvaldo Degrossi 1966 10 p refs, In SPANISH

(CNEA-172) CFSTI: HC $1.00/MF $0.50

The plasmatic volume and corpuscular mass of 10 normal and 6 subjects suffering from anemia and polycythemia were determined using seralbumin labelled with I^{131} and red corpuscles labelled with Cr^{51}. The values obtained using the combined methods were used to calculate the total blood volume. Any differences noted were not significant from a statistical point of view. In comparing the erythrocyte mass of women with men, the women had less. Plasmatic volume in women was also less. However, there were no statistically significant differences between normal and pathological subjects in either corpuscular or total blood volume. For more exact measurements, the volume should be determined separately. The study demonstrated the value and feasibility of the two procedures. I^{131} is easier to use than Cr^{51} but is affected by the purity of the albumen used. R.N.A.

N66-35755# Joint Publications Research Service, Washington, D. C.

SLEEP AND ELECTRIC SLEEP IN CHILDREN

L. Ya. Rabichev 25 Aug. 1966 12 p Transl. into ENGLISH from Pediatrya (Moscow), v. 45, no. 6, Jun. 1966 p 7–10 Presented at the 1st Rep. Sci. and Pract. Conf. of Pediatricians of the Moldavian SSR, 31 Oct. 1964

(JPRS-37218; TT-66-33647) CFSTI: $1.00

Standards of physiological sleep established in relation to age are discussed, and a simple scheme is suggested for determining the average norms of sleep duration in children

and adolescents. The importance of the depth of sleep is also discussed, with differentiation made between somnolence, superficial sleep, sleep of medium depth, and deep sleep. Hygienic and therapeutic measures for normalizing sleep are mentioned. The effectiveness of electric sleep therapy for treating sleep deficiencies in children is evaluated, based on the results of clinical observations over a 10-year period. It is pointed out that the treatment is carried out simultaneously with medicinal and physiotherapeutic measures. The recommendation is made that this therapy should be used in treating certain neuropsychic and neurosomatic diseaseases of children. M.G.J.

N66-35762# Joint Publications Research Service, Washington, D. C.

LIGHT MEASUREMENTS IN THE STUDY OF PRIMARY PRODUCTION IN THE SEA

O. I. Koblents-Mishke and Yu. Ye. Ochakovskiy 16 Aug. 1966 17 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 6, no. 3, 1966 p 535–542

(JPRS-37033; TT-66-33463) CFSTI: $1.00

Several approaches to the problem of determining what light measurements are necessary for biological oceanography are examined, and proposed apparatus and measurement methods are assessed. The possibility of constructing and using an equivalent detector is discussed, and the design requirements for such instruments are listed. The difficulties caused by the complexity of the measurements, and computations of the radiant energy propagating in the sea are pointed out. Two principal measurement classifications are defined: (1) direct measurements of total energy; and (2) optical measurements for subsequent computations of this energy at some horizon. A simpler approach is considered in which underwater irradiation measurements are carried out in one narrow region of the spectrum. Recommendations for standardizing measurement methods are also proposed. M.G.J.

N66-35763# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF ELECTROMAGNETIC AND MAGNETIC FIELDS ON THE CENTRAL NERVOUS SYSTEM

Yu. A. Kholodov 18 Aug. 1966 30 p Transl. into ENGLISH from Vliyaniye Elektromagnitnykh i Magnitnykh Poley na Tsentral'nuyu Nervnuyu Sistemu (Moscow), 1966 p 100, 137–138, 199–200, 223–224, 252–259, 281–283

(JPRS-37102; TT-66-33531) CFSTI: $1.00

Research results are presented for studies conducted to determine the influence of the superhigh frequency field (SHF), and the continuous magnetic field (CMF) on the electric activity of the rabbit brain; on the development of conditioned reflexes to electromagnetic fields (EMF) in rabbits, pigeons, and fish; to analyze the production mechanism of conditioned reflexes to a magnetic field in fish; and on the histological changes of the brain under the influence of electromagnetic fields. General conclusions based on the overall study of electromagnetic and magnetic field effects on the central nervous system are also presented. Among the findings discussed are: (1) Electrophysiological experiments showed elements of similarity between the physiological action of CMF, UMF, and SHF fields, and ionizing radiation. (2) The fact that EMF has the strongest influence on the main regulatory center of the brain, where neural and humoral pathways of integration converge, led to the assumption that even weak exposure of this center may induce significant physiological changes. M.G.J.

N66-35772*# IIT Research Inst., Chicago, Ill.

LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, 15 May–15 Aug. 1966

Charles A. Hagen [1966] 31 p ref

(Contract NASr-22)

(NASA-CR-77612; IITRI-L6023-6) CFSTI: HC $2.00/MF $0.50 CSCL 06F

Simulated Martian environment experiments designed to determine the effects of barometric pressure and carbon dioxide concentration on germination of *Bacillus cereus* spores were concluded. It was found that *B. cereus* spore germination was inhibited by CO_2 concentrations of 37, 67, and 100% at all pressures. Pressures as low as 10-mb with Earth atmosphere were not inhibitory to spore germination, however, vegetative cell growth was less than that at 98-mb. Similar experiments to determine the effects of the same barometric pressures and CO_2 concentrations on *Staphylococcus aureus* indicated that earth atmosphere at 40-mb pressure with a constant temperature of 35°C or diurnal temperature cycling did not inhibit the growth of this organism. Soil ecology experiments on the growth response of *B. cereus, Lactobacillus plantarum, Pseudomonas aeruginosa*, Putrefactive Anaerobe (PA 3679), and *S. aureus* in an alkaline California desert soil with 99% relative humidity and a constant temperature of 35°C or diurnal temperature cycling indicated that: (1) *L. plantarum, P. aeruginosa*, and *S. aureus* do not survive even at cell populations of 10^5 cells/g of soil; and (2) *B. cereus* and PA 3679 spores survive at spore populations as low as 10^2 spores/g of soil with less than a one log die-off after 56 days. S.C.W.

N66-35774*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.

THE INVERSION ILLUSION IN PARABOLIC FLIGHT: ITS PROBABLE DEPENDENCE ON OTOLITH FUNCTION

Ashton Graybiel and Robert S. Kellogg 20 Jul. 1966 19 p refs

(NASA Order R-93)

(NASA-CR-77628; NAMI-974) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Observations were made on normal subjects and deaf persons with bilateral labyrinthine defects (L–D subjects) under three different conditions in parabolic flight: (1) free-floating, (2) restrained in a Fiberglas mold, and (3) standing on the overhead during a modified parabola generating about −0.05 G unit. There were interindividual differences in the reactions among the normal but not among the L–D subjects. Some normal but none of the L–D subjects experienced a reversal of their personal orientation with regard to up–down under all three conditions. This reversal was considered to have its genesis in the vestibular organs, probably the otolith apparatus. Our findings are in accord with Russian reports describing feelings of inversion among cosmonauts in orbital flight. Attention is called to the necessity of distinguishing between information furnished by touch-pressure, kinesthesis, and stereagnosis under ordinary conditions and agravic touch-pressure, agravic kinesthesis, and agravic steragnosis. Author

N66-35785*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.

RADIATION AND THE FIRST BIOPOLYMERS

Sidney W. Fox [1965] 34 p refs Presented at the Symp. on Radiation and the Origin of Life of the 3d Intern. Congr. of Radiation Res., Cortina D'Ampezzo, Italy, 28 Jun. 1966

(Grant NsG-689)

(NASA-CR-77688) CFSTI: HC $2.00/MF $0.50 CSCL 07E

Models attempting to portray the stuff and structure of the life protocell are reviewed and discussed; and the effects of radiation in the formation and durability of the polymers implicated are considered. The role of polyanhydro-α-amino acids, and polynucleotides in the synthesis of the cellular

polymers, and the thermodynamics of peptide bond formation in an open system are discussed. The catalytic activities indicated in thermal polyanhydro-α-amino acids are tabulated. Some of the evidence for the limited heterogeneity of a 2:2:3-proteinoid is also given in a table. The compositions of the hydrolyzates of these proteinoids after repeated fractionation are almost identical. Also presented is a table showing the distribution of three kinds of assayable amino acids in two proteinoids. The evidence indicates that the interactions of individual amino acids lead to a high degree of order in the resultant polymers. Other properties (solubilities, optical activity, etc.) which the thermal polymers possess in common with proteins; and properties which proteinoid microspheres have in common with cellular systems, are also listed. The effect of radiation on the amino acids in ovalbumin in aqueous solution; and the origin of prebiotic and nonenzymic polynucleotides are also discussed. L.S.

N66-35804*# Missouri Univ., Columbia.
TEMPERATURE PREFERENCE IN GOLDEN HAMSTERS
M. R. Gumma, F. E. South and J. N. Allen (N. Mex. St. Univ.) [1966] 17 p refs Prepared in Cooperation with N. Mex. St. Univ.
(Grants NGR-26-004-025; Nonr(G)-0001; NIH-GM-09584)
(NASA-CR-77562) CFSTI: HC $1.00/MF $0.50 CSCL 06C

The preference of pre- and post-hibernative hamsters and rats for relatively cool (8°C) or relatively warm (19°C or 24°C) environmental temperatures was tested in a T-maze using the method of forced choice to equate number of visits to and total time spent in each environment. The findings of the experiment showed that rats had a strong preference for 24° as opposed to 8°C environments. Pre-hibernative hamsters preferred an 8° environment to either a 19° or 24°C environment. Following arousal, hamsters shift their preference for an 8° environment to a 24°C environment. The significance of these results is discussed in terms of possible purposive thermoregulatory behaviors. Author

N66-35823# Argonne Cancer Research Hospital, Chicago, Ill.
SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION
Leon O. Jacobson and Margot Doyle, ed. Sep. 1965 195 p refs
(Contract AT(11-1)-69)
(ACRH-24) CFSTI: HC $3.00/MF $1.00

Information concerning activities in various biological and medical fields associated with cancer research is presented in nineteen papers. The information in these papers was published previously. NSA

N66-35824# Argonne National Lab., Ill.
RADIOLOGICAL PHYSICS DIVISION ANNUAL REPORT, JULY 1964–JUNE 1965
[1965] 140 p refs
(Contract W-31-109-ENG-38)
ANL-7060) CFSTI: HC $4.00/MF $1.00

Research is reported on biphenyl transitions, spectra of aromatic molecules, energy transfer in Ar–N mixtures, gas-phase ion recombination, photo-excitation, isotope effects in photoionization of benzene, isotope effects in ionization, energy transfer effects on luminescence, properties of the generalized oscillator strength, radioinduced osteosarcoma, radiosensitivity of rotifers, beta dosimetry, response of LiF to fast neutrons, LiF neutron image storage, NEUTBAK and RPY 157X programs for cosmic neutrons, ionization of gases by electrons, status of thorotrast-dosed personnel, whole-body counting methods, RPY-139 program for mixtures of gamma-emitters, underground counting facility air measurements, Mössbauer effect from bones, Mössbauer effect in ^{133}Cs, Ra and Sr concentrations in bone, blood, and soft tissue, bone-seeking radioisotopes, ^{226}Ra effects on bones, ^{133}Ba retention by beagles, natural distribution of Th and U, estimation of Th and U in bone, Sr retention by mice, collagen formation and ossification in mice, gamma emission by thorotrast patients, background in low-level gamma facility, multi-channel analyzer data processing, multitube preamplifiers, detection of atmospheric ionized columns, ^{222}Rn measurements, air pollution survey instruments, atmospheric vertical heat flux determinations, and instrumentation for atmospheric turbulence studies. NSA

N66-35981*# Martin Co., Denver, Colo.
GNOTOBIOTIC SURVEY REPORT
Jul. 1966 30 p refs
(Contract NASw-1407)
(NASA-CR-77779; VOY-CR-66-5) CFSTI: HC $1.00/MF $0.50 CSCL 06M

This report on gnotobiotic technology contains a concise summary of the historical development and present status. Selected abstracts related to gnotobiotic technology are provided. These abstracts, selected from files on sterilization technology, have been included to show the scope of gnotobiotic work as well as to identify valuable papers. Author

N66-36043# Army Biological Labs., Fort Detrick, Md.
MICROBIOLOGICAL BARRIER TECHNIQUES
G. Briggs Phillips Dec. 1965 38 p refs *Its* Tech. Manuscript No. 260
(AD-626085) CFSTI: HC $2.00/MF $0.50

Microbiological barriers prevent the migration of microbial contaminants. Historically, the use of barriers in laboratory operations was documented as early as in the 19th century. In relation to the steps normally taken to detect and control microbiological contamination, the tests used with microbiological barrier systems include air sampling, surface sampling, filter and air incinerator testing, and gas-tightness testing. Microbiological barrier systems can be classified according to purpose, size, and degree of containment. Sterilization and decontamination agents are used with barrier systems for initial or terminal treatment, for the treatment of supplies and equipment moved in or out of the system, and for the maintenance of its microbiological state during use. Irrespective of the shape and material used for microbiological cabinet barriers, there are certain desirable minimum features. Photographs of a number of present day microbiological barriers and barrier systems are presented. Author (TAB)

N66-36058*# Florida State Univ., Tallahassee. Dept. of Statistics.
BIOSTATISTICS OF SPACE EXPLORATION: MICROBIOLOGY AND STERILIZATION
Richard G. Cornell 24 Aug. 1966 15 p refs
(Grant NGR-10-004-029)
(NASA-CR-77803) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Statistical analyses of problems arising in the decontamination of spacecraft and related studies of microbial life are discussed. Work towards developing a probability distribution function for representing the information available on the probability of contaminating Mars was started. Appropriate distributions for spacecraft parts of components which are of a type that can be subjected to microbial assay are being developed. The distributions will be combined to obtain a probability distribution of contamination for the spacecraft as a whole. In addition to the work on these contamination probability models, research on nonlinear statistical estimations

which is directly applicable to microbial assays is also reported. Other efforts discussed which relate to the study include: (1) the development of nonparametric, distribution-free procedures for testing parallelism of regression lines (a problem which occurs often in bioassay), and (2) the estimation of parameters in a bioassay model with logarithmic die-off and with microbial counts observed for each plate studied. L.S.

N66-36082# RAND Corp., Santa Monica, Calif.
A DOCUMENTARY ON WEIGHT, DIET AND EXERCISE
R. C. Drebelbis May 1966 91 p refs
(P-3196-1; AD-633860) CFSTI: HC $3.00/MF $0.75

The paper presents authentic scientific data on correct weight, diet and exercise as essential to physical fitness and general good health. It contains a chart to determine your metabolism or the calories per day that you will require to lose weight and then to maintain a desired level. A complete nutritive calorie chart of foods arranged in alphabetical order is included. The caloric value of the foods listed is shown in convenient measurements of average portions or servings. There is a conversion table which relates weights and measurements to standard food portions in daily use. The document is organized into two parts: Part I deals with weight and diet and Part II discusses exercise and physical fitness. Part II also includes a series of back flexion exercises recommended for those individuals who suffer recurring back problems.
Author (TAB)

N66-36070* Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
[STUDIES OF THE PREPARATION AND PROPERTIES OF THERMAL POLY-α-AMINO ACIDS AND THERMAL POLYNUCLEOTIDES] Semiannual Status Report, 1 Jun.–1 Dec. 1965
[1965] 11 p refs
(Grant NsG-689)
(NASA-CR-77856) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Properties of thermal poly-α-amino acids and polynucleotides, and the behavior of microscopic units which organize spontaneously when amino acids condensates are brought into contract with water are studied. The catalytic property of protenoids is discussed, and it is pointed out that protenoids, like proteins, have many activities because of their chemical polyfunctionality. Examinations on the degree of heterogeneity of thermal protenoids are mentioned, and results from the optical resolution of amino acids by a stereoselective ligand exchange and by inoculation of supersaturated solutions of racemate are covered. Research on protenoid microspheres subjected to increased pH is described, and a photograph from the microscopic examination is included. A.G.O.

N66-36075*# Florida State Univ., Tallahassee. Dept. of Statistics.
DILUTION MODEL: A BAYESIAN APPROACH Technical Report No. 6
Andres Petrasovits 24 Aug. 1966 30 p refs
(Grant NGR-10-004-029)
(NASA-CR-77799) CFSTI: HC $2.00/MF $0.50 CSCL 06A

A Bayesian approach is applied to the dilution method as a means for estimating, without any direct count, the density of bacterial organisms in a liquid. Two main problems are investigated: (1) Bayes estimation of the bacterial density for a given set of dilution levels, and (2) design of the typical dilution experiment, making use of the existing prior information about bacterial density, so as to minimize the expected value of an appropriate cost function. The probability model for this method is based on the assumptions that the organisms are distributed randomly throughout the liquid, and that each sample from the liquid when incubated in the culture medium is certain to exhibit growth whenever the sample contains one or more organisms. The Bayes estimate and Bayes risk used in the determination of the density parameter and experiment design are expressed in the form of polygamma functions, and several suggestions of extensions to the Bayesian treatment of the estimation and design problems involved in dilution experimentation are also given. A.G.O.

N66-36081*# Florida State Univ., Tallahassee. Dept. of Statistics.
A NOMENCLATURE OF SYMBOLS RELEVANT TO THE PROBABILITY OF CONTAMINATING MARS Technical Report No. 5
Richard G. Cornell 24 Aug. 1966 12 p
(Grant NGR-10-004-029)
(NASA-CR-77753) CFSTI: HC $1.00/MF $0.50 CSCL 06T

A nomenclature of symbols is given which is useful in developing expressions for the probability of contaminating Mars under a variety of conditions. The symbols designating probability concepts are presented, and the conventions regarding the designation of events are delineated. It is shown that many pertinent probability symbols can be developed from these basic event symbols using the defined conventions and operations. It is also pointed out that an advantage of this system is that it is easy to incorporate new events into the definitions either by operating on events already defined or by introducing new basic event notation. A.G.O.

N66-36152# Eidgenossische Technische Hochschule, Zurich (Switzerland).
COMPARISON OF THE EFFECT OF VARIOUS DRUGS ON A PAIN REACTION AND ON THE MOTOR PERFORMANCE OF RATS [VERGLEICH DER WIRKUNG VERSCHIEDENER PHARMAKA AUF EINE SCHMERZREAKTION UND AUF DIE MOTORISCHE LEISTUNGSFAEHIGKEIT VON RATTEN]
Silvio Schudel 1965 100 p refs In GERMAN
(Rept.-3660) CFSTI: HC $3.00/MF $0.75

Simultaneous analgetic and sedative effects of drugs on albino rats were studied by their subjective responses to electrical irritation of their anal skin folds and their swimming speed and endurance, respectively. Various tests showed that morphine and chlorpromazine possessed both, analgetic and sedative effectiveness; aspirin, pyramidon, phenacetin, butazolodin, and combinations of phenacetin/coffein, phenacetin/pyramidon, pyramidon/coffein, and phenacetin/pyramidon/coffein had weaker sedative effects; veronal-sodium pharmaceutics proved more sedative than analgetic, and coffein did not produce any analgetic or sedative results. Transl. by G.G.

N66-36160# Turin Univ. (Italy). Hematology Lab.
RESEARCH ON CELLS AND CHROMOSOMES IN HUMAN LEUKEMIA [INDAGINI SULLE CELLULE E SUI CROMOSOMI DI LEUCEMIA UMANA] Final Report, 1962–1965
F. Gavosto, A. Pileri, and L. Pegoraro Brussels, EURATOM, Apr. 1966 48 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-016-62-1 BIOI)
(EUR-2764.i) CFSTI: HC $2.00/MF $0.50

In the research on cells and chromosomes in human leukemia, the following lines of enquiry were pursued: (a) cytogenetic studies, (b) DNA duplication in the chromosomes of normal and leukemic blood cells, (c) proliferative and maturative potential of acute leukemia cells, (d) RNA metabolism in acute leukemia cells, and (e) effect of exogenous RNA on the protein metabolism of normal and leukemic cells. It emerged from the cytogenetic study that in about 60% of cases of acute leukemia the karyotype is morphologically

normal, whereas in chronic myeloid leukemia cases approaching the acute stage the Ph^1 anomaly is persistent. With regard to the chromosomes, DNA synthesis was found to follow a characteristic pattern in both leukemic and normal cells. It was found that the reduction in the proliferative capacity of the acute leukemia cells is related to the degree of such cells' failure to differentiate. It was also observed that within a given population of acute leukemia blasts the proliferative failure becomes increasingly pronounced with age. In systems incubating in vitro, it was found that the addition of exogenous RNA increases the leucine uptake in both leukemic and normal blood cells. Author

N66-36178# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.

THE MEASUREMENT OF THE DOSE-EQUIVALENT FROM THERMAL AND INTERMEDIATE-ENERGY NEUTRONS WITH PERSONNEL DOSIMETERS

J. A. Dennis, J. W. Smith, and S. J. Boot Jul. 1966 19 p refs (AERE-R-5238) CFSTI: HC $1.00/MF $0.50

Factors influencing the readings of personnel neutron dosimeters, particularly the cadmium covered film and the nuclear emulsion types, are discussed. The influences of the intermediate-energy and fast neutrons back-scattered from the body at thermal energies and of the gamma radiation generated in the body by the $^1H(n\gamma)^2D$ reaction are considered. It is shown that these phenomena enable reasonably accurate estimations of the dose-equivalent from neutrons with energies in the range thermal to 10 KeV to be made and, with certain assumptions about the neutron spectra, also an approximate estimate over the range thermal to 0.3 MeV. Author

N66-36226# Honeywell, Inc., St. Paul, Minn. Systems and Research Div.

A COMPUTER SYSTEM FOR INTRASPECIES BIOLOGIC AND BEHAVIORAL VARIABILITY STUDIES, 1-28 FEBRUARY 1966

Norman A. Sidley, David C. Brown, and Stirling P. Stackhouse Brooks AFB, Tex., School of Aerospace Med., Jun. 1966 9 p (Contract AF 41(609)-2937)

(SAM-TR-66-60; AD-636913) CFSTI: HC $1.00/MF $0.50

An analytical system is described for the computer analysis of variables pertinent to the study of intraspecies biologic and behavioral variability. This program can be used for the selection of appropriate variables, for predicting which variables should be selected for future study on radiation effects, and for statistical significance testing. Author (TAB)

N66-36232# Federation of American Societies for Experimental Biology, Washington, D. C. Life Sciences Research Office.

STUDY OF RESEARCH METHODOLOGY FOR USE IN THE DEVELOPMENT OF ANTI-RADIATION AGENTS

Wendell H. Griffith and Helen M. Dyer 15 Jan. 1966 50 p refs (Contract DA-49-092-ARO-70)

(AD-633394) CFSTI: HC $2.00/MF $0.50

Contents: Evaluation of research procedures employed in the screening and development of effective and safe anti-radiation agents; properties of an ideal anti-radiation agent; present status of research methodology employed in the search for and development of anti-radiation agents; nature and general manifestations of radiation damage and protection; methodology and significance of the mouse screening test and of other procedures employed in the search for anti-radiation agents and in the evaluation of radiation protection potency; survival of irradiated mice with and without a protective agent; determination of radiation protection by measurement of intracellular recovery and of the reparative proliferation of tissues; method of assessment of radiation protection potency; chemical, pharmacologic, and toxicologic properties of anti-radiation agents. TAB

N66-36236# Bureau of Social Science Research, Inc., Washington, D. C.

THE TRANSFORMATION OF FEAR Technical Report, 1963-1966

Samuel Z. Lkausner Jan. 1966 41 p refs

(Contract AF 49(638)-1510)

(AFOSR-66-0123; AD-631020) CFSTI: HC $2.00/MF $0.50

Hypothesis: (1) Fear and enthusiasm are negatively correlated components of affectual excitement. (2) In acting despite fear, fear is transformed into enthusiasm (the affectual valence shift from negative to positive); i.e., fear at one point is posivitely correlated with enthusiasm at a later point in the act. A sample of 825 American sport parachutists indicated the degrees of fear and enthusiasm experienced during their first jump. The data were examined by regression analysis of the fear and enthusiasm scores. During the jump preparation both fear and enthusiasm increase. At the start of the jump run, fear decreases and enthusiasm increases. A nadir and zenith, respectively, are reached when the parachute is opened. Fear again increases and enthusiasm decreases near landing. Upon touching the ground, fear drops to a new nadir and enthusiasm rises to a zenith above the first. The mean scores for fear and for enthusiasm at successive points during the jump are negatively correlated. At single points, individual fear and enthusiasm scores are also negatively correlated. These findings support the first hypothesis. The individual fear scores at the first zenith of fear are less negatively and then more positively correlated with individual enthusiasm at successive subsequent points; this finding supports the second hypothesis. A deviant case analysis showed that those who transform their fear into a relatively great amount of enthusiasm tend to be independent, energetic personalities, while those who fail, relatively, to transform the fear into enthusiasm tend to be passive, dependent personalities. Author (TAB)

N66-36251# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

AVIATION MEDICINE REPORTS: AN ANNOTATED CATALOG OF OFFICE OF AVIATION MEDICINE REPORTS, 1961 THROUGH 1965

Mary Ellen Allen and Stanley R. Mohler Jan. 1966 34 p refs (AM-66-1)

An annotated catalog of Office of Aviation Medicine Reports is presented as a quick reference for those engaged in civil aviation and related activities. It provides an applied summary, Author Index, and Subject Index of each OAM Report published from 1961 through 1965. Author

N66-36252# European Atomic Energy Community, Brussels (Belgium). Medical Service.

ACTION OF PADUTIN ON ACUTE AND CHRONIC RADIODERMATITIS [WIRKUNG VON PADUTIN BEI AKUTER UND CHRONISCHER RADIODERMATITIS]

S. Simon (Brussels Univ.), A. Massart, and J. Rodesch Jun. 1966 36 p refs In ENGLISH, GERMAN, ITALIAN, FRENCH, and DUTCH Presented at the 11th World Radiol. Congr., Rome, 22-28 Sep. 1965

(EUR-2752-d,f,i,n,e.) CFSTI: HC $2.00/MF $0.50

Deinsulinized pancreatic extracts (Padutin) have a cicatrizing trophic action on torpid wounds. When used in the treatment of acute and chronic radiolesions they give promising results. In man, the treatment of accidental radio-necroses and serious effects of radiotherapy gives good results in 80% of cases, failures in 16%, resistance in 4%. A marked

diminution of pain recurs almost immediately. The extreme diversity of radio-lesions makes it necessary to draw up a therapeutic plan for each individual case. The treatment period varies from two months to one year. It is helpful to continue administering booster doses. The same treatment can be re-applied successfully should the lesions recur. Positive results have been obtained in cases of acute and chronic cutaneous radio-necrosis, radio-myositis, radio-necrosis of the cervix, the bladder, the mucous membranes, the bones, and in instances of delayed cicatrization, etc. Author

N66-36270# California Univ., Berkeley. Lawrence Radiation Lab.

SCINTILLATION PHOTOGRAPHY OF INTRAVASCULAR CLOTS *IN VIVO* WITH ^{131}I-LABELED PLASMINOGEN

William C. Berger 9 Feb. 1966 15 p refs
(Contract W-7405-ENG-48)
(UCRL-16691) CFSTI: HC $1.00/MF $0.50

The injection of 5 μC of ^{131}I-labeled human plasminogen (SK activated) demonstrated within 5 minutes the presence of a fresh, experimentally made intravenous clot in an otherwise intact living rabbit. The Anger scintillation camera was used to produce photographic representation of the clot. Author (NSA)

N66-36349# Eidgenossische Technische Hochschule, Zurich (Switzerland).

PHYSICAL-CHEMICAL PROPERTIES AND LOCAL ANESTHETIC RESULTS OF AN ETHER SUBSTITUTE OF PROCAIN . [PHYSIKALISCH-CHEMISCHE EIGENSCHAFTEN UND LOKALANAESTHETISCHE WIRKUNG EINIGER ESTER-ANALOGEN VON PROCAIN]

Guido Fischer (Ph.D. Thesis) 1965 87 p refs In GERMAN
(Rept.-3675) CFSTI: HC $3.00/MF $0.75

Synthesis and properties of several isosteric procaine derivatives were described and their local-anesthetic effects on nerve fibers were evaluated. These derivatives showed the greatest anesthetic effectiveness when their distribution coefficient, surface activity, and carbon adsportion index was high, their pH degree of turbidity was deep, and their solubility in water was low. A substitution of the carbonyl group in procaine derivatives by —S—, —O—, —CH_2—, —NH—, and —SO_2—groups generally decreased their anesthetic effectiveness. Transl. by G.G.

N66-36356# European Atomic Energy Community, Ispra (Italy).

VALUE OF GAMMA SPECTROMETRY APPLIED TO BIOLOGICAL SAMPLES [VALEUR DE LA SPECTROMETRIE GAMMA APPLIQUEE AUX ECHANTILLONS BIOLOGIQUES]

H. Tanguy and V. Camera Jul. 1966 26 p refs In FRENCH; ENGLISH summary
(EUR-2998.f) CFSTI: HC $2.00/MF $0.50

The analysis of biological samples has not as many applications as wholebody counting, nevertheless, it has some value when applied to biological specimens such as urine and feces. The authors establish the normal spectra for urine and feces and find a net increase in ^{137}Cs in urine after the middle of 1963. Body burdens calculated from the concentrations in the urine were higher at Ispra than in other places where the same measurements were done. The authors report results on spectra of some cases of slight contamination that were found at Ispra. Contamination was due to ^{203}Hg, ^{154}Cs, ^{152,154}Eu and other uranium fission products. Author

N66-36371*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DESERT ALGAE: SOIL CRUSTS AND DIAPHANOUS SUBSTRATA AS ALGAL HABITATS

R. E. Cameron and G. B. Blank 15 Jul. 1966 41 p refs
(Contract NAS7-100)
(NASA-CR-77982; JPL-TR-32-971) CFSTI: HC $2.00/MF $0.50 CSCL 06F

In terrestrial desert environments, favorable microenvironments are found in the soil that promote the development of algae and associated organisms and a subsequent accumulation of organic matter. The most favorable habitats in desert soils occur in algal and lichen soil crusts, and on the undersurface of translucent or transparent materials partially imbedded in the soil surface. Algal abundance is increased and ecological factors are much less restrictive in these ecological niches than in the surrounding desert soil. Insolation is modified, more moisture is retained, desiccation is reduced, and organic matter accumulations are noticeable. Characteristics of translucent materials, such as white or milky quartz and chalcedony, which are partially imbedded in the surface of desert soils, permit the existence of mesophilic algal inhabitants, such as species of coccoid, blue-green algae, that do not normally occur as components of xeric soil populations. Other species are cosmopolitan forms occurring in a wide range of environments, including habitats at low or high elevations in hot or cold deserts. The probable occurrence of a number of translucent and transparent minerals in extraterrestrial soils and other geological materials may also provide a favorable ecological niche or microenvironment for organisms and associated organic matter in an otherwise harsh macroenvironment. Author

N66-36373*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography, Jul. 1966

Aug. 1966 178 p refs With Indexes
(NASA-SP-7011(27)) CFSTI: HC $1.00/MF $1.25 CSCL 06S

This continuing bibliography serves as an abstracting and announcement medium for references on aerospace medicine, exobiology, radiation effects on biological systems, physiological and psychological factors, life support systems, human engineering, protective clothing and equipment, crew training and evaluation, and piloting. Subject, corporate source, and personal author indexes are included. H.S.W.

N66-36377# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

PROBLEMS IN AVIATION PERSONNEL: INFLUENCE OF A TRANQUILIZER ON TEMPERATURE REGULATION IN MAN

P. F. Iampietro, V. Fionica, J. R. Dille, E. A. Higgins, G. Funkhouser et al May 1966 10 p refs
(AM-66-14)

The effects of a tranquilizing drug of the propaediol group, meprobamate, on thermal balance of men exposed to a cold (50°F, 10°C), hot (110°F, 43.3°C), or neutral (80°F, 26.7°C) environment have been investigated. Results show that a single dose of meprobamate (800 mg) has no effect on temperature regulation of men resting in a neutral environment. During exposure to hot or cold environments, however, the drug groups showed impairment in thermal balance. In the cold, heat production and core temperature of the drug group were lower than the placebo group. In the heat, only moderate elevations in the core temperatures of the drug group were detected. Possible physiological mechanisms responsible for these differences are discussed. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-35519*# Northrop Space Labs., Hawthorne, Calif.
THE PHYSICAL CAPABILITIES AND LOGISTIC SUPPORT REQUIREMENTS FOR MAN ON THE MOON
Walter Kuehnegger *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 417–436 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75
(Contract NAS1-4449)

This paper describes the application of biomechanical principles to the determination of his physical capabilities and those of work physiology in the determination of his logistic support requirements. A combination of biomechanical and physiological data has been used to derive the efficiency and optimization of man in the performance of simulated lunar working tasks. The data presented concerns itself primarily with self locomotion experiments. It is shown how the data developed by this method can be applied as a part of the basic guideline in the preparation of manned lunar surface missions. As such, it will contribute to the safe and successful completion of the mission objective. Author

N66-35520*# AiResearch Mfg. Co., Los Angeles, Calif.
THE COST OF LIFE SUPPORT IN MANNED LUNAR BASES
W. L. Burriss *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 437–471 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75
(Contract NAS8-11447)

This paper concerns the comparative costs for life support in relatively large lunar bases provided with crews ranging from 3 to 18 men. Early lunar bases will have relatively high expendable usage rates and consequently will be limited to mission durations of less than approximately 3 months (without logistic resupply). The ultimate lunar base, to be achieved by evolution through progressively more sophisticated systems, will incorporate extensive provisions for the reclamation of useful materials from human wastes. The life support system concept described is based upon use of modules to permit growth in mission capability by modular addition of life support equipment and supplies to the systems used in earlier missions. Consideration is given to the operational costs associated with base monitoring, housekeeping, and system support activities to determine the resources available for the performance of the scientific mission tasks. Author

N66-35521*# Agriculture Dept., Beltsville, Md.
TERRESTRIAL AGRICULTURE PLANT AND ANIMAL RESEARCH AS APPLICABLE TO EXTRATERRESTRIAL FOOD PRODUCTION
Robert G. Yeck *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 472–480 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

The intent of this presentation is to alert the space scientist to agricultural research as a resource for solving problems of extraterrestrial food production. The general organization for agricultural research within the United States and a discussion of the range of activities that are being conducted is given. Included are some specific examples of research that might have direct application to space problems. For example, recent studies on the effect of CO_2 concentration on vegetables have shown head weight of lettuce to increase progressively with each successive level of CO_2 concentration. The levels of exposure were 500, 800, 1200, and 1600 ppm. The average weight of okra plants were about four times greater in beds with 1600 ppm of CO_2 than in beds with 400 ppm exposure. Rates of heat dissipation and the identification of the method in which it is dissipated are subjects of some of the animal research. Skin vaporization has been identified as an important means of heat dissipation among animals previously considered as "non-sweating." Author

N66-35522*# RAND Corp., Santa Monica, Calif.
WEIGHTS OF ENVIRONMENT-CONTROL SYSTEMS
S. H. Dole *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 481–487 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

Some generalized relationships are presented that can be used for estimating weights of environmental-control equipment and expendables required for supporting human beings on space missions. Dry weights are extracted from contractor reports and defined as items of equipment employed in breathing-gas supply, carbon dioxide removal, humidity control, trace contaminants removal, fresh water supply, thermal control, and waste management. Weights are correlated by using a single mathematical expression. Total weights of environmental-control systems are estimated by adding weights of expendables to dry weights. Expendables include metabolic supplies, reactants, make-up for leakage of atmospheric gases, and metabolic stores for contingencies. These empirical correlations are presented for quick estimating purposes when all details are not available. S.P.

N66-35523*# Litton Industries, Inc., Beverly Hills, Calif.
LEAKAGE IN LIFE SUPPORT SYSTEMS
Arthur F. Sullivan *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 489–494 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

This paper briefly considers a small, but nevertheless essential, element of any extraterrestrial exploration activity—the leakage of gases from life support systems. In particular, we will examine both the logistic and the design consequences of leakage from space suits during extraterrestrial activity. To date space suits have been characterized by very high leak rates. In spite of the moderate, 3.7 psi, operating pressures employed by the current generation of operational suits, leak rates in excess of 160 scc/min are typical. To a reasonable approximation one can, in fact, assume that all of the life support system leakage occurs in the suit. Further, marked increases in suit leakage with wear, and as the result of don/doff manipulations, have come to be accepted as inevitable. Increases in gas losses resulting from wear generally range from 50 to 100% during the useful life of current suit types. Author

N66-35590# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
A STUDY OF TECHNIQUES AND EQUIPMENT FOR THE EVALUATION OF EXTRAVEHICULAR PROTECTIVE GARMENTS Final Report, Aug. 1964–Jun. 1965
David G. Parry, Le Roy R. Curry, Jr., Donald B. Hanson, and George B. Towle Wright-Patterson AFB, Ohio, AMRL, Feb. 1966 427 p refs
(Contract AF 33(615)-1780)
(HSER-3671; AMRL-TR-66-4; AD-635206) CFSTI: HC $3.00/MF $2.00

The purpose of this study was to establish a test methodology and a test system for objective, quantitative, and accurate evaluation of extravehicular space protective garments. Areas of testing studied include functional performance, life support, and environmental protection. Emphasis is placed

on the problem of suit torque restraints, i.e., mobility. Concepts for appropriate evaluation criteria are discussed. The information presented and conclusions reached are the results of experience in suit testing, technical analysis, search of the literature, and discussions with experts. The nature and causes of suit torque restraint are discussed and a pin jointed model is developed for precise description of suit torques and body interlink angles. Various techniques for torque vector and body angle measurements are explored and it is concluded that a powered articulated dummy and an intra-suit exoskeletal electrogoniometer with off-line computer coupling are required to produce accurate data and useful figures of merit. Measurement techniques for reach envelope, glove evaluation, and comfort are also discussed. Various approaches to thermal and respiratory system evaluation were studied and steady state manned tests at moderate altitudes with minimum suit-wall heat transfer are recommended. The meteoroid, vacuum, thermal, and radiation hazards of space are reviewed and direction for further study in these fields is suggested. Overall facility requirements for suit evaluation are discussed and a digital data acquisition system for conditioning, editing, recording, and processing of functional and life support data is described. Author (TAB)

N66-35637# San Jose State Coll., Calif.

A REVIEW OF EFFORTS TO ORGANIZE INFORMATION ABOUT HUMAN LEARNING, TRANSFER, AND RETENTION Final Report, Jul.–Nov. 1965

Rose Ginsberg, John C. Mc Cullers, John J. Meryman, Calvin W. Thomson, and Robert S. Witte Wright-Patterson AFB, Ohio. AMRL, Mar. 1966 42 p refs

(Contract AF 33(615)-2951)

(AMRL-TR-66-23; AD-635491) CFSTI: HC $2.00/MF $0.50

Efforts pertaining to organizing available information on human learning, transfer, and retention are summarized and evaluated on six criteria: behavioral significance of categories, scope, objectivity and reliability of categories, prognosis for the system, logical structure, the heuristic value of the system. Attention is also given to several other sources of guidance for organizing information on human learning. The review indicates at least six major approaches to a taxonomy of human learning. The bases for these different approaches are: (1) general or limited theoretical factors, (2) conditions of learning including the learner, (3) individual differences, (4) physical characteristics of learning tasks, (5) task characteristics in relation to empirical variables, and (6) task characteristics in relation to learning principles. In some cases the approaches are combined. The major conclusion is that although some contributions have been made to a general organization of information on human learning, intense and detailed efforts toward a comprehensive taxonomy are only in a preliminary formative phase. Author (TAB)

N66-35706# Stanford Research Inst., South Pasadena, Calif. Southern Calif. Labs.

FEASIBILITY OF REMOVING GASEOUS CONTAMINANTS FROM MANNED SPACE-CABIN ATMOSPHERES BY IONIC PROCESSES Final Technical Report, 1 Mar.–31 Oct. 1965

George J. Doyle and Robert G. Caldwell Wright-Patterson AFB, Ohio. AMRL, Feb. 1966 71 p refs

(Contract AF 33(615)-2405)

(SSU-5396; AMRL-TR-66-22; AD-635522) CFSTI: HC $3.00/MF $0.75

The application of ionic processes to the purification of manned space-cabin atmospheres was investigated in anticipation of a need for a radically new atmospheric purification system for some of the presently scheduled space journeys. Processes considered are (1) ion-molecule reactions of contaminant molecules with specific added molecule ions (O_2^+, O_2^-) and (2) clustering of contaminant molecules about specific ions (H_3O^+). Either reaction type can lead to charging of the contaminant molecules (or molecules derived therefrom), allowing collection by an externally applied electric field. Ion-molecule reactions were found to be potentially useful for removal of a large class of contaminant species. However, charge-trapping reactions involving such species as water and oxygen-occurring or energetically capable of occurring concurrently or subsequently to the desired reaction-could interfere, thereby allowing no clear-cut decision as to the applicability of ion-molecule reactions to purification. Clustering was investigated in greater detail than ion-molecule reactions. Detailed calculation of ion-polar molecule interaction energies for typical molecules were carried out. Author (TAB)

N66-35725# Atomic Energy Commission, Washington, D. C. Div. of Operational Safety.

PROCEEDINGS OF THE USAEC FIRST SYMPOSIUM ON ACCELERATOR RADIATION DOSIMETRY AND EXPERIENCE

[1965] 697 p refs Conf. held at Upton, N. Y., 3–5 Nov. 1965 (CONF-651109) CFSTI: HC $6.75/MF $2.75

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5. BIOLOGICAL ASPECTS p 601–652 refs

N66-35739# Aviation Safety Engineering and Research, Phoenix, Ariz.

TEST RESULTS—HEMISPHERICAL SPECIMENS. SUPPLEMENT II TO HELMET DESIGN CRITERIA FOR IMPROVED CRASH SURVIVAL

J. W. Turnbow (Ariz. Univ.) and J. L. Haley, Jr. Jan. 1966 21 p

(Contract DA-44-177-AMC-254(T))

(USAAVLABS-TR-65-44B, Suppl. 2; AD-628880) CFSTI: HC $1.00/MF $0.50

The results of impact tests on 27 different types of helmet construction are presented. Materials used in each specimen and the total weight of each are given in tabular form, as well as acceleration onset rate, maximum (peak) acceleration, rebound height, and deformation of the simulated scalp. The 90-degree corner impactor drops were compared at 6 and 4 ft, and the flat impactors at 5 and 6 ft. A comparison of the acceleration values indicated that only three specimens yielded acceptable acceleration values combined with reasonably low specimen weights (0.10 in. thick 8-ply nylon-epoxy, 0.40 annealed magnesium, and 0.40 annealed aluminum specimens). Two other specimens (0.04 magnesium and 0.04 aluminum) could be acceptable if the foam density were reduced. L.E.W.

N66-35838# Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.

DATA FROM RADIATION PROTECTION PROGRAMS, VOLUME 4, NO. 2

Feb. 1966 41 p refs

(NP-15951)

Procedures used by the Radiation Protection Division to ensure that exposure of radiation workers and of the general

public will remain within the acceptable limits as defined by the guides are discussed. Guide levels in radiation protection programs are considered. Data are presented on: Canadian fallout data for January 1966; ^{137}Cs activity in seal samples; and reactor environment monitoring for January 1966. A selected list of 10 divisional reports and bulletins available to the public on request is included. NSA

N66-36919*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SAFETY PROBLEMS ASSOCIATED WITH CRYOGENIC SYSTEMS FOR SPACE ENVIRONMENT FACILITIES

Daniel J. Peters *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 101-106 ref (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

An accident that occurred while operating a space environment simulator is described. The accident exemplifies the existence of safety hazards when operating cryogenic systems and emphasizes the need for strict adherence to regulations to ensure the safety of operating personnel. The symptoms of anoxia are discussed and safety practices to guard against the exclusion of oxygen in confined areas are examined. The hazardous conditions arising from the inadvertent buildup of high pressures in lines or containers are also cited. H.S.W

N66-36937*# TRW Systems, Redondo Beach, Calif.

VISUAL DETECTION OF POINT SOURCE TARGETS

R. A. Shea and L. G. Summers Washington, NASA, Sep. 1966 71 p refs

(Contract NAS2-2742)

(NASA-CR-563) CFSTI: HC $2.50/MF $0.75 CSCL 05H

An experimental investigation of an observer's ability to detect, with the unaided eye, a target satellite in a rendezvous mission is presented. The target was represented by a point source of light moving in a simulated starfield background. Efforts centered on determining the time taken and the accuracy attained by an observer to detect the target, and on delineating the search techniques used by the observer in performing the task. Experimental results showed that detection time depends on target velocity, starfield density, and field-of-view. Other experimental data showed that there was an appreciable difference in mean detection time between modes of starfield presentation—15 sec for the same starfield background contrasted with 150 sec for the unique starfield group. There was no positive or negative transfer of training from one type of starfield presentation to the other. Two models are proposed to explain the observer's search strategy, one for each type of presentation. S.P.

N66-36999# Federal Aviation Agency, Oklahoma City, Okla.

EVALUATION OF HEAD AND FACE INJURY POTENTIAL OF CURRENT AIRLINE SEATS DURING CRASH DECELERATIONS

John J. Swearingen Jun. 1966 20 p refs

(AM-66-18)

A large percentage of deaths in commercial-airline crashes is produced as the body and lower limbs flail around the seat belt. According to a previous study, a 10-foot-diameter sphere of clear area would be necessary to prevent a person from striking some portion of his body against surrounding structures. This study is concerned primarily with head impacts that may occur against most portions of the seats. Thirty-five impact studies were made with an instrumented dummy head against various portions of eight different makes of airline seats to determine the "g" time-force parameters of metal deformation and seat break-over. Until recently these data could not be interpreted in terms of head injury or unconsciousness because data on human tolerance to impact against deformable structures were not available; however, a recently published study presents detailed data concerning these tolerances. These data are used here to determine the injury potential of the eight seats studied. Applying the earlier data to the seat-impact studies, 30% of these impacts would have produced fatal head injuries, 80% would have caused facial fractures, 97% would have rendered the passenger unconscious, and only 3% would have caused no injury or unconsciousness. Author

N66-36089*# General Mills, Inc., Minneapolis, Minn. Atmospheric and Aerosol Physics Research.

MICROSCOPIC SYSTEM FOR MARS STUDY PROGRAM (FEASIBILITY STUDY) Final Report, 30 Oct. 1961-31 Mar. 1962

R. E. Peterson, R. Ginsberg, V. W. Greene, D. Lundgren, D. Rotenberg et al 30 Apr. 1962 168 p refs Prepared for JPL *Its* Rept.-2274

(Contracts NAS7-100; JPL-950123)

(NASA-CR-50429) CFSTI: HC $5.00/MF $1.00 CSCL 06D

The results of a five-month study program have indicated that a feasible design concept can be developed for a remote, automatic microscopic system of Martian life-detection. Environmental samples would be collected, refined, and microscopically observed; video-micrographs of specimens with a high probability of containing biological constituents (if indeed, they are present) would be transmitted back to Earth. The individual study phases have included environmental factors, inferred characteristics of Martian microorganisms, sample collection, sample processing, microscopic observation and detection, and overall system analysis. Author

N66-36110*# Serendipity Associates, Los Angeles, Calif.

A STUDY OF POTENTIAL ROLES OF SUPERSONIC TRANSPORT CREWS AND SOME IMPLICATIONS FOR THE FLIGHT DECK. VOLUME I: WORKLOAD, CREW ROLES, FLIGHT DECK CONCEPTS, AND CONCLUSIONS

Harold E. Price, William D. Honsberger, and William J. Ereneta Washington, NASA, Aug. 1966 319 p refs

(Contract NAS2-2209)

(NASA-CR-561) CFSTI: HC $3.75/MF $1.75 CSCL 05H

The data developed from a study of the potential roles of supersonic transport crews was analyzed to investigate crew workload, distribution of this workload among different numbers of crew members to define potential crew roles, and implications of these potential roles for flight deck design. The results obtained substantiated the general conclusions that a realistic workload must be developed and utilized for SST crew simulation studies; the full time capabilities of a three man crew may be required for SST operations; monitoring tasks will contribute substantially to the crew workload and unique monitoring techniques may be necessary; and flight management operations are changing to a more cognitive performance rather than neuromuscular, and new man-machine interface concepts must be developed to support this role. Additional conclusions are drawn and recommendations for further study are made. H.S.W.

N66-36131*# General Dynamics Corp., Groton, Conn. Electric Boat Div.

WATER RECLAMATION SUBSYSTEMS FOR SPACE STATIONS

J. A. Steele, J. A. Lubitz, H. Wallman, H. Miner, and V. Speziali 3 Jul. 1963 79 p refs

(Contract NAS1-2208)

(NASA-CR-66168; U413-63-103) CFSTI: HC $3.00/MF $0.75 CSCL 06K

Three multi-filter subsystems were designed, built, and tested; they were found to give recovered water of the required quality. The dehumidification water subsystem produced potable water from air-conditioning condensate obtained from a space simulator. The washwater subsystem and the fecal water subsystem both produced water suitable for use as wash water. The actual weights of the multi-filter subsystems for a 1-year mission are: dehumidification water subsystem—9.3 lb, wash water subsystem—100.1 lb, fecal water subsystem—28.9 lb, and storage racks for spare canisters—6.9 lb. These weights are not minimum and could be reduced by further design and development. The frequency of canister replacement, and hence subsystem weights, are highly dependent on the composition of the waste waters. Canister life can best be determined by test operation in a manned space simulator. Based on the amount of water remaining in the subsystems, the following water recovery efficiencies were calculated: dehumidification water subsystem—99.5%, wash water subsystem—99.0%, and fecal water subsystem—96.0%. Author

N66-36144# Bureau of Mines, Pittsburgh, Pa. Respirator Section.

GAS MASKS FOR RESPIRATORY PROTECTION AGAINST AMINES

Edwin J. Kloos, Leno Spinetti, and Lewis D. Raymond 1966 13 p refs

(BM-IC-8296) GPO $0.15

Previously approved gas masks were evaluated to determine their ability to provide respiratory protection against each of the following six selected amines: ethylenediamine, diethylamine, n-butylamine, ethylamine, methylamine, and hydrazine. Minimum requirements were a 24-minute service life at a flow rate of 64 liters per minute (32 liters per minute for hydrazine) and an amine concentration of 1.0 volume-percent (0.5 volume-percent for hydrazine). The three masks meeting these requirements were the LG4, Willson Products Division, The Electric Storage Battery Co.; the GMD-SS, Mine Safety Appliances Co.; and the 084-PHOV-R, Acme Protection Equipment Co. Author

N66-36227# Prodesco, Inc., Perkasie, Pa.

DEVELOPMENT OF REVISED SIMPLEX FABRIC FOR SUMMER FLYING GLOVES

Hal E. Brockmann Johnsville, Pa., Naval Air Develop. Center, 1 Jul. 1966 10 p

(Contract NADC-5243/65)

(NADC-MR-6607; AD-636423) CFSTI: HC $1.00/MF $0.50

An improved simplex knitted fabric was developed for use in summer flying gloves which would effect better protection in the event of exposure to flames and reduce or eliminate the difficulties encountered with the filament simplex fabric. The fabric was to conform to all the requirements needed for comfort, serviceability and protection. All manufacturing techniques utilized in this effort were to conform to and be compatible with standard commercial methods for reproducing the finished product. The primary difficulties encountered in the fleet evaluation of the filament glove were limited to seam slippage and glove fit. Since the seam slippage presents a problem in serviceability, it is proposed that the yarn structure be modified from a continuous filament yarn to a yarn spun from short length staple fibers. This in itself would effect a greater degree of surface cohesiveness within the fabric structure and thus help to hold the seams in place. As far as the glove fit in the thumb area was concerned, a simple modification of the pattern accomplished the change. TAB

N66-36241# Electronic Systems Div., Bedford, Mass.

DIRECT VS INDIRECT ASSESSMENT OF SIMPLE KNOWLEDGE STRUCTURES Technical Report, May 1964–Jan. 1965

H. Edward Massengill and Emir H. Shuford, Jr. Mar. 1966 55 p refs

(ESD-TR-65-542; AD-632609) CFSTI: HC $3.00/MF $0.50

The report compares two types of classroom testing in terms of efficacy in guiding instruction. One type of testing is the traditional indirect method based on the observation of choices. The other type is the direct method based on admissible probability measurement. The general finding is that the direct methods always perform as well as and in most cases better than the indirect methods. This deficiency in the indirect method can be alleviated in theory by introducing redundancy into the test and asking the same question over and over again. The performance of indirect methods depends in a very critical manner upon the information available to the instructor from other sources about the current state of knowledge of each student. The performance of the direct methods is unaffected by this. The gain in effectiveness achieved by using direct methods must be balanced off against the cost of using these new methods. A direct method may require more student time per item than does an indirect method. This, however, may be more than compensated for by the requirement for redundancy when using the indirect method. In addition, since a direct method does not require additional information from the instructor as to the current state of knowledge of each student, the possibility exists that much larger classes may be taught with no loss in effectiveness thus implying even further economic benefits from the use of direct methods to guide classroom instruction.

Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-35478# Joint Publications Research Service, Washington, D. C.

STEROIDS. XLVIII: THE HYDROXYLATION OF Δ5,16,20-PREGNATRIEN-3β, 20-DIOL DIACETATE BY POTASSIUM PERMANGANATE

Zi-wu Wang and Huang Minlon *In its* Transl. on Communist China: Sci. and Technol. 15 Aug. 1966 p 1–8 refs Transl. into ENGLISH from Hua-Hsueh Hsueh-Pao (Peking), v. 32, no. 1, Feb. 1966 p 58–63 (See N66-35477 21-34) CFSTI: $1.00

On treating Δ5,16,20-pregnatrien-3β,20-diol diacetate(V) with potassium permanganate, a hydroxylation product was obtained. Its structure has been assumed to be X instead of VI as previously proposed. When the tetrol (VIII) was treated with acetone-perchloric acid, it formed the acetonide XII, but not XIII as reported in the literature. The latter was prepared from another route starting with VI. Based on these results we suspect the correctness of the assumption that 16α, 17α, 21-trihydroxy-20-keto steroids form 16,17-acetonides under the described conditions. Author

N66-35509*# General Electric Co., Philadelphia, Pa.

CHEMICAL BONDING AND SHEAR STRENGTH OF SILICATE SYSTEMS UNDER LUNAR CONDITIONS

Rodney W. Johnson and John M. Greiner *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 131–193 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

It is shown that experimental evidence exists to support the conclusion that chemical bonding and interparticle force effects are exhibited by particles of the lunar dust layer. Additionally some physical properties of simulated dust models reflecting these bonding and force effects are discussed. The experimental portion of this research was concentrated on investigating the irradiation effects on falling silica powders; penetration and bearing strength measurements of silica and granodiorite powders under varying conditions of radiation, vacuum, and deposition; and measurements of adhesion between solid silicates in ultra-high vacuum. The results showed that granular silicates will become bonded in environmental conditions closely approximating those of the moon; dust dropped in a lunar environment produces a more flocculent structure than in air due to the increased importance of surface force effects over gravitational effects and the influence of ionizing radiation; and that covalent bonding can occur at silicate/silicate and silicate/metal interfaces providing the metal oxide layer can be penetrated. The implications of these results in lunar surface models are assessed. H.S.W.

N66-35528# Pennsylvania State Univ., University Park. Dept. of Physics.

INFRARED ABSORPTION SPECTRA OF ISOTOPIC DIMERIC HYDROGEN CHLORIDE MOLECULES

D. H. Rank, W. A. Glickman, and T. A. Wiggins *In its* [Opt. Phenomena in Liquid and Gaseous Media] [1965] 13 p refs Supported in part by NSF (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

The spectra of HCl and of HCl mixed with DCl at 195°K were observed in the region of the HCl fundamental band. In HCl three prominent lines occur in the null gap. Smaller complex features were observed in the region extending from R(0) to P(3). The intense lines at 2891.2, 2889.8 and 2889.0 cm^{-1} had relative intensities of 1:0.6:0.1. These lines are due to the HCl dimer with a heat of formation of 2.1 kcal/mole. Treating the HCl–HCl molecule as a coupled nearly resonant system, only two lines of relative intensity of 1:0.3 would be expected corresponding to the dimers (HCl^{35}–HCl^{35}, HCl^{35}–HCl^{37}) and (HCl^{37}–HCl^{35}, HCl^{37}–HCl^{37}) for the resolution possible with these broad features. With the HCl–DCl mixture two additional lines were observed of separation 2.1 cm^{-1} and relative intensity 1:0.34. These are attributed to the dimers (HCl^{35}–DCl^{35}, HCl^{35}–DCl^{37}) and (HCl^{37}–DCl^{35}, HCl^{37}–DCl^{37}). Assuming non-resonant coupled oscillators the measured frequencies can be computed within experimental error using a reduced mass for the molecule calculated by adding to the Cl^{35} or Cl^{37} the $\Delta H/D_o$ fraction of the mass of DCl, where ΔH is the heat of formation and D_o the dissociation energy of HCl. Author

N66-35536# Pennsylvania State Univ., University Park. Dept. of Physics.

CENTER OF DISPERSION FORCES IN HCl INTERACTING WITH RARE GAS ATOMS

R. M. Herman *In its* [Opt. Phenomena in Liquid and Gaseous Media] [1965] 22 p refs (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

A variational calculation of the center of long range forces in HCl is described. The calculation is performed in two ways. In the first, the center of polarizability is calculated through a consideration of the polarization energy for the molecule placed in an inhomogeneous electric field, and the center is assumed identical with that effective in long range interactions. In the second, a direct calculation of the dispersion forces between HCl and the rare gases Ar and He is made, and from their angular dependence, the position of the effective center of attraction of HCl to the rare gas atom is deduced. The calculations, which take account of the anisotropy of the HCl orbitals, yield a value for the separation between the HCl center of mass and center of long range force equal to 0.11 Å, with a small variation from one rare gas to another. The long range isotropic force constant and the HCl polarizability components are also calculated through the present approach. Comparison of the calculated parameters with experiment is made whenever this is possible. Author

N66-35604*# Geological Survey, Washington, C. D.

SEMI-MICRO X-RAY FLUORESCENCE ANALYSIS OF TEKTITES USING 50 MILLIGRAM SAMPLES

Harry J. Rose, Jr., Frank Cuttitta, Maxwell K. Carron, and Robena Brown *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 75–84 refs (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00 CSCL 08D

X-ray fluorescence spectroscopy is adapted to permit semi-microanalysis of rare specimens, such as tektites, where only small quantities of material are available. Radiation intensity at the detector is increased by the (1) elimination of air from the spectrometer via evacuation of the chamber by flushing the chamber with helium or (2) absorption reduction via the use of supported thin film windows. Sample sizes were reduced to 50 mg by determining the minimum layer of fused sample necessary to maintain the desired signal for the elements being analyzed. The fusion mixture consists of 50 mg of the sample, 50 mg La_2O_3, and 340 mg of $Li_2B_4O_7$, and was fused at 1100°C for 10 minutes and then cooled in a graphite crucible. Six Java tektites were analyzed for Si, Al, Fe, Ca, K, Mn, and Ti oxides composition; and a comparison of the X-ray and chemical results indicates close agreement of values obtained by the two methods. Silica contents for the six specimens ranged from 72.3 to 74.4%; alumina between 11.1 and 11.6%. Indices of refraction ranged from 1.5073 to 1.5141. M.W.R.

N66-35616# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

CHEMICAL DOSIMETRY SYSTEMS

C. Rainbolt *In its* Manual of Radiation Dosimetry Expt. Nov 1965 p 144–164 refs (See N66-35608 21-04) CFSTI: HC $6.00/MF $1.25

An aqueous solution of trichloroethylene and an acidimetric dye is prepared for a chemical dosimetry system, and is evaluated by visual comparison against color standards. The system is then calibrated against a known gamma ray source and the dosimeter is used to determine unknown gamma doses absorbed in water. For general information, see N66-35608. N.E.N.

N66-35628# Colorado Univ., Boulder.

NITROSO AND NITRO FLUOROHALOALKANES Final Report, May 1, 1961–May 1, 1964

J. D. Park [1964] 82 p refs

(Contract DA-ARO(D)-31-124-G69)

(AROD-3027-1; AD-635299) CFSTI: HC $3.00/MF $0.75

The report summarizes work in a program which was primarily concerned with the study of new approaches to the syntheses of polyhalonitrosoalkanes and similarly related derivatives. Another objective was the study of various inorganic compounds as possible catalysts for the addition of NO, NO_2, and NOCl across olefinic bonds. The kinetics of decarboxylation of some acyl nitrites were investigated. Vapor pressure measurements were also made in order to obtain the latent heats of vaporization as well as values for the Trouton's constant. Author (TAB)

N66-35639# Polytechnic Inst. of Brooklyn, N. Y.
HIGH PRESSURE CHEMISTRY AND STRUCTURE Progress Report, Oct. 1, 1965–Mar. 31, 1966
E. Banks and B. Post [1966] 9 p
(Contract DA-31-124-ARO(D)-70)
(PR-5; AD-635652) CFSTI: HC $1.00/MF $0.50

Progress is reported in the following areas: calibration and operation of a high-pressure X-ray camera; development of a high-pressure differential thermal analysis technique; phase studies and syntheses of intermetallic rare-earth compounds, aluminum nitride, and the oxides WO_3, Li_xWO_3 (where X= 0.4–0.5), NbO_2, $LiNbO_2F$, and $EuNbO_3$. TAB

N66-35664*# American Univ., Washington, D. C.
INVESTIGATION OF ELECTROCHEMISTRY OF HIGH ENERGY COMPOUNDS IN ORGANIC ELECTROLYTES Third Progress Report, Nov. 1, 1965–Apr. 30, 1966
R. T. Foley, L. E. Helgen, and L. Schubert [1966] 40 p refs
(Grant NGR-09-003-005)
(NASA-CR-62034) CFSTI: HC $2.00/MF $0.50 CSCL 07C

This phase of the investigation has been concerned with the chemical and electrochemical properties of the cyclic esters, gamma-butyrolactone and propylene carbonate. The reactions of these esters with the metals Na, K, Li, Ca, and Mg have been studied. Reaction of butyrolactone with Na indicates that both condensation and ring opening with the formation of the sodium salt of a hydroxy carboxylic acid occurs along with the evolution of hydrogen. Chlorine reacts with propylene carbonate both at room temperature and at 100°C to yield a chemical species that absorbs in the UV. Work has continued on the range of electrolysis of the cyclic esters particularly in connection with establishing a suitable reference electrode. The stability of the silver reference electrode was measured. On the basis of experimental evidence as well as literature reports it was concluded that the silver–silver ion reference was most suitable for the non-aqueous systems under investigation here. Author

N66-35675# Centro Brasileiro de Pesquises Fisicas, Rio de Janeiro.
ELECTRON SPIN RESONANCE OF TRAPPED ELECTRONS IN IRRADIATED SODIUM NITROPRUSSIDE
J. Danon, R. P. A. Muniz, and H. Panepucci 1965 11 p refs
Its Nota de Fis., Vol. 11, No. 19
CFSTI: HC $1.00/MF $0.50

The radiation-induced defects in strongly paramagnetic, powdered sodium nitroprusside irradiated with 2 MeV electrons were investigated. The results lead to the conclusion that a secondary electron is trapped in an antibonding orbital of the diamagnetic $|FeII(CN)_5NO|^{2-}$, forming the paramagnetic $|FeI(CN)_5NO|^{3-}$, with the $3d^7$ spin-paired configuration for the central ion. Single crystals of sodium nitroprusside were irradiated, and two resonance triplets were observed. The $e(\pi^b)^4(b_2)^2(a_1)^1$ configuration is proposed, giving a $^2A_1$ ground state for the $|FeI(CN)_5NO|^{3-}$ molecule, with the unpaired electron in the d_z^2 orbital. N.E.N.

N66-35676# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
CONTRIBUTION TO THE ENHANCED DIFFUSION OF NI-63 IN ALPHA-IRRADIATED PURE COPPER
W. Schuele Jun. 1966 16 p refs
(EUR-2968.e) CFSTI: HC $1.00/MF $0.50

A theoretical model is applied to experimental results of Ni-63 diffusion in pure copper. With this model the sink concentration and the concentration of the point defects during alpha-irradiation is estimated. Finally it is shown that the Ni-63 atoms diffuse by an interstitialcy diffusion mechanism during the irradiation Author

N66-35679# European Atomic Energy Community, Ispra (Italy). Materials Dept.
ISOTHERMAL TRANSPORT PROCESSES IN MOLTEN SALTS BINARY SYSTEMS
A. Berlin, B. Langevin (Centre d'Etudes Nucl., Saclay, France), S. Forcheri, and V. Wagner Jun. 1966 21 p refs Presented at the 16th CITCE Meeting, Budapest, 5–10 Sep. 1965
(EUR-2954.e) CFSTI: HC $1.00/MF $0.50

Transport numbers determinations in the molten systems $(Cs–Ag)NO_3$ at T=240°C, $(Na–Tl)NO_3$ at T=320°C and in $CsNO_3$ rich region of $(Na–Cs)NO_3$ system at T=440°C, were carried out by means of an ionophoretic technique. The inert support was provided by a thin layer of fritted porous ceramic oxides (Al_2O_3, MgO or ZrO_2) fixed on strips of sintered ceramic oxides (Al_2O_3 or ZrO_2) with zero open porosity. In both the systems $(Cs–Ag)NO_3$ and $(Na–Tl)NO_3$ the measured transport numbers vary in a non-linear way with composition, indicating that ionic mobilities are not constant. From the transport parameters liquid junctions potentials were calculated. These values never exceed 8 mV $(Cs–Ag)NO_3$, and 3 mV $(Na–Tl)NO_3$. Author

N66-35726*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
[THE TERRESTRIAL ORIGINS OF MACROMOLECULES AND OF CELLS]
Sidney W. Fox [1965] 37 p refs Presented at Colloq. on Elementary Biol. Systems and Abiogenesis, Paris, 23–25 Nov. 1965
(Grants NsG-689; NsG-173-62)
(NASA-CR-68594) CFSTI: HC $2.00/MF $0.50 CSCL 06A

Investigations which can lead to the explanation of the origin of biopolymers in the absence of cells and chemist, and the spontaneous conversion of the polyamino acid type of such polymers to the first cells, are reviewed. Proteinoids, proteins, and catalytic activities relevant to the properties attributed to the first living material are emphasized. It is concluded that preclusive assumptions based on the historical priority of the gene are not justified. It is further concluded that moderately controlled heating of α-amino acids can readily yield a polymer which, by simple contact with water, would easily organize itself into a minimal kind of membranous cell, having catalytic, fissile, and other activities imitating those of the true biological unit. N.E.N.

N66-35749# Southwest Research Inst., San Antonio, Tex.
ANALYTIC AND EXPLOSIVE TECHNICAL INVESTIGATIONS ON SILVER ACETYLIDE [ANALYTISHE UND SPRENGSTOFFTECHNISCHE UNTERSUCHUNGEN AN AZETHYLENSILBER]
Robert Stadler Aug. 1966 56 p refs Transl. into ENGLISH from Z. Ges. Schiess. und Sprengstoffwesen (Germany), v. 33, no. 10, Oct. 1938 p 269–272, 302–305, 334–338
(TR-2)

The explosive characteristics of silver acetylide are examined, and the dependence of the detonation temperature of such compounds on its preparation is assessed. It is shown that the properties of silver acetylides precipitated from neutral or acid solutions depend largely on their treatment after precipitation. The results on explosion gas analyses are compiled for silver acetylides from an ammoniac solution, from a neutral solution, and from a nitric acid solution. Methods for measuring the detonation velocity are described. Lead block expansion for initiating explosives is discussed, and initiation experiments with silver acetylide are detailed. Storage stability is considered, along with measurements of the heats of explosion. The brisance values are calculated. The important explosive technical characteristics of silver acetylide are compared with other initiating explosives such as mercury fulmi-

nate, lead styphnate, and lead azide. Results show that the silver acetylide is characterized by high density, large heat of explosion, and smaller detonation velocity. M.G.J.

N66-35771* Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.

PROSPECTUS FOR CHEMICAL SYNTHESIS OF PROTEINACEOUS FOODSTUFFS

Sidney W. Fox [1966] 32 p refs Presented at the Conf. on Closed Life Support Systems, Moffett Field, Calif., 15 Apr. 1966 /ts Inst. of Mol. Evolution Contrib. No. 069

(Grant NsG-689)

(NASA-CR-77611) CFSTI: HC $2.00/MF $0.50 CSCL 06H

Procedures of pansynthesis which focus on the chemical synthesis of food for space travel, and inherent problems associated with the use of free amino acids as foods; are analyzed. Emphasized are two approaches (condensation polymerization and Leuchs anhydrides) to the simultaneous inclusion of all essential amino acids in petide bonds in polymers of amino acids. Speculation is made concerning the importance of studies of free amino acids and of protein-like polymers, to space nutrition. S.C.W.

N66-35800*# Harvard Coll. Observatory, Cambridge, Mass. Shock Tube Spectroscopy Lab.

ON THE $6s6p^2\ {}^2S_{1/2}$ LEVEL AND THE CONFIGURATION-MIXING OF THE $6s6p^2\ {}^4P_{3/2}$ LEVEL IN Tl I Scientific Report No. 11

W. R. S. Garton (Imperial Coll.), W. H. Parkinson, and E. M. Reeves May 1966 15 p refs

(Grants NsG-438; Nonr-1866(48))

(NASA-CR-77639) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Experiments on the absorption spectrum of shock-heated Tl vapour have revealed a new Tl I doublet ($6^2P_{1/2,3/2}$–$6s6p^2\ {}^2S_{1/2}$). The profile of the Tl I ($6\,{}^2P_{1/2}$–$6s6p^2\ {}^4P_{3/2}$) autoionization feature has been obtained by experiments with a furnace and scanning monochromator, and the result is compared with the theory of "Beautler-Fano" resonances. Author

N66-35807# Argonne National Lab., Ill.

DETECTION SENSITIVITIES IN THERMAL-NEUTRON ACTIVATION

James Wing and Morris A. Wahlgren Dec. 1965 106 p refs

(Contract W-31-109-ENG-38)

(ANL-6953) CFSTI: HC $4.00/MF $0.75

Detection sensitivities of the chemical elements in thermal-neutron activation are compiled from the available experimental cross sections and nuclear properties. The counts per minute per microgram of target element by techniques of 4π counting, single-gamma counting, gamma-gamma coincidence counting, beta–gamma coincidence counting, and triple-coincidence counting are tabulated for irradiation times of 0.5, 5, 50, 500, and 5000 min at a flux of 10^{14} thermal nuetrons/sec-cm^2. For single-gamma counting, the source is 3 cm and 9.3 cm from the face of a 3-in. by 3-in. NaI(Tl) crystal. For coincidence counting, the source is 3 cm from two opposed 3-in. by 3-in. NaI(Tl) crystals. The results on the single-gamma countings are compared with the existing experimental data. Several applications of this compilation are discussed. Author (NSA)

N66-35817# Iowa State Univ. of Science and Technology, Ames. Ames Lab.

PARTIAL MOLAL HEAT CAPACITIES OF SOME AQUEOUS RARE-EARTH CHLORIDE SOLUTIONS AT 25°C

K. C. Jones and F. H. Spedding Nov. 1965 85 p refs

(Contract W-7405-ENG-82)

(IS-1355) CFSTI: HC $3.00/MF $0.75

An adiabatic calorimeter was designed and built to measure the specific heats of aqueous solutions at 25°C with a precision of at least 0.05%. Specific heats were determined for a number of aqueous solutions of lanthanum, neodymium, dysprosium, erbium, and ytterbium chlorides at 25°C. The concentration range covered was from 0.1 molal to saturation (approximately 4.0 molal). From the specific heat data, apparent molal heat capacities were calculated for each of the rare-earth chloride solutions. The apparent molal heat capacity results for each salt were expressed as a function of the square root molality by means of a fourth degree polynomial equation. Partial molal heat capacities of the solute and solvent were calculated for each rare-earth salt from these polynomial equations. The apparent molal heat capacity data obtained indicate the rare earths may be divided into two subgroups at moderate concentrations, with the heavy rare earths belonging to one group and the light rare earths to another. This behavior was qualitatively explained by assuming that the heavy rare-earth ions have a lower coordination number for water than the light ones, and evidence to support this assumption was presented. The partial molal heat capacities showed possible evidence for complex-ion formation near saturation. NSA

N66-35822# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

DETERMINATION OF FLUORIDE BY PYROHYDROLYSIS AND AUTOMATED COLORIMETRY

David E. Harrington and Robert S. Dorsett Dec. 1965 14 p refs

(Contract AT(07-2)-1)

(DP-1004) CFSTI: HC $1.00/MF $0.50

A pyrohydrolytic-colorimetric method was developed for the determination of fluoride in the presence of high concentrations of interfering elements. Adaption of the colorimetric reaction of fluoride with the lanthanum chelate of alizarin complexone to an automated system gave a minimum detectable limit of 0.050 μg/ml of fluoride in pure solutions and 25 μg of total fluoride in samples that required the pyrohydrolytic separation from interferences. The relative standard deviation of the method is better than 1% at twenty times the limit of detection. Author (NSA)

N66-35867# California Univ., Livermore. Lawrence Radiation Lab.

SHOCK COMPRESSION OF ARGON

M. Van Thiel and B. J. Alder 14 Jun. 1965 37 p refs

(Contract W-7405-ENG-48)

(UCRL-14251) CFSTI: HC $2.00/MF $0.50

Liquid argon was shock-compressed from two initial states at 86°K and 2 bars, and at 148.2°K and 70 bars. The highest pressure of 700 kbars and temperature of 13000°K were obtained by reflecting a shock wave with a pressure of 270 kbars from a tungsten wall. These shock loci allow a test of the interatomic potential over a wide region and show that the potential can be represented by a sum of pair interactions over a large pressure range. The pair potential is furthermore found to be considerably less repulsive at small interatomic distances than the twelve power repulsive law. In fact, an exponential form yields good results up to 360 kbars. Above this pressure range the reflected shock data require a large change in the potential form which is interpreted to be due to a pressure induced electronic transition to the conduction band. Calculations show that a discontinuity in the Hugoniot data at 50 kbars and 1200°K could be identified with the melting line. This temperature corresponds to three times the highest reduced melting temperature observed so far. Author (NSA)

N66-35949*# Union Carbide Plastics Co., Bound Brook, N. J. Polymer Research and Development Dept.

SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT AND HYBRID SOLID GRAINS Quarterly Report No. 3, 1 May–31 Jul. 1966

J. E. Potts, ed., A. C. Ashcraft, Jr., E. M. Sullivan, and E. W. Wise [1966] 32 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951210)

(NASA-CR-77798) CFSTI: HC $2.00/MF $0.50 CSCL 11A

The new technique of gel permeation chromatography was used to determine the molecular weight distributions of a wide variety of ethylene–neohexene copolymers. The ratio $\overline{M}_w/\overline{M}_n$ was found to be between 1.2 and 1.5 for the samples studied. The data accumulated in this study provide strong reasons for preferring molecular weight data obtained in polar solvents such as tetrahydrofuran, to similar data obtained when non-polar solvents are used. Molecular distillation is effective for fractionating ethylene–neohexene copolymers in the molecular weight range of 200–800. The fractions so obtained have very narrow molecular weight distributions. DEAB has been used to make several additional polymerization runs. Techniques have been worked out for the hydrolysis of these products, whose complete characterization is still in progress. Dimethyl α,α'-azobisisobutyrate (DMAB) has been synthesized from readily available materials in a four step synthesis with an overall yield of 58%. Author

N66-35952*# National Aeronautics and Space Administration, Washington, D. C.

MINERALOGICAL-STRUCTURAL FEATURES OF THE SEVRYUK STONY METEORITE

I. A. Yudin May 1966 22 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 14, 1956 p 101–109

(NASA-TT-F-10126) CFSTI: HC $1.00/MF $0.50 CSCL 08G

The microstructural features of the sevryuk stony meteorite, in its three color variants, are discussed. Predominantly elliptical chondrules, of both mono- and polysomatic types and mostly of olivine and rhombic pyroxene composition were found in all three variants. The quantitative ratios of minerals in the meteorite are tabulated, showing the presence of iron and troilite in the black variety and nickel–iron with an iocite shell in the gray types. The iocite content points to thermal metamorphism; the black and dark gray varieties are interpreted as modifications of the light gray type. Author

N66-35953*# National Aeronautics and Space Administration, Washington, D. C.

OPAQUE MINERALS OF STONY METEORITES [NEPROZRACHNYYE MINERALY KAMENNYKH METEORITOV]

I. A. Yudin May 1966 44 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 16, 1958 p 78–104

(NASA-TT-F-10127) CFSTI: HC $2.00/MF $0.50 CSCL 08G

Minerographic studies of opaque minerals, including nickel–iron, nickel-free iron, native copper, iocite, and ilmenite, in chondrites and achondrites, are discussed, with photomicrographs of grain distribution of the minerals in the groundmass and tabular data on chemical composition. In chemical composition and structure, the nickel–iron is analogous to that in iron meteorites; the nickel-free iron has been formed by troilite substitution; the ilmenite is similar to the terrestrial variety. Author

N66-35956*# National Aeronautics and Space Administration, Washington, D. C.

TITRIMETRIC SEMIMICRO DETERMINATION OF FUNCTIONAL GROUPS IN HUMIC PREPARATIONS [TITROMETRICHESKIY POLUMIKROMETOD OPREDELENIYA FUNKTSIONAL'NYKH GRUPP V GUMINOVYKH PREPARATOV]

T. A. Kukharenko Aug. 1966 14 p refs Transl. into ENGLISH from Zh. Analit. Khim. (Moscow), v. 3, no. 3, 1948 p 181–185

(NASA-TT-F-10251) CFSTI: HC $1.00/MF $0.50 CSCL 07C

Previous unsatisfactory titrimetric macro determination of functional groups in humic preparations led to this semimicro method. Tests are described in detail. The method is found to be fast, simple, and uses nonpoisonous reagents. Author

N66-35983# Bureau of Mines, Minneapolis, Minn. Metallurgy Research Center.

ADSORPTION PHENOMENA AND THE REDUCTION OF IRON OXIDES. MECHANISM OF REDUCTION OF IRON OXIDES WITH CARBON MONOXIDE

S. E. Khalafalla, C. W. Schultz, and T. N. Rushton 1966 30 p refs

(BM-RI-6832)

The Bureau of Mines investigated the kinetics of reduction of wustite and magnetite with carbon monoxide. A mechanism was postulated wherein the interaction between gaseous and absorbed carbon monoxide appears to be the rate-determining process. This mechanism fully accounts for the experimental rate equation which relates the velocity of reduction to the pressure of the reducing gas at constant temperature. It also explains the variability of the heat of activation of the reduction process with the state of aggregation of the oxide material. The integrated rate equation is in perfect agreement with the experimental reduction-time curves. Author

N66-35994# Bureau of Mines, Reno, Nev. Metallurgy Research Center.

DENSITY AND MOLAR VOLUMES OF BINARY FLUORIDE MIXTURES

Bernard Porter and R. E. Meaker 1966 21 p refs

(BM-RI-6836)

The densities of LiF, NaF, and KF, of binary mixtures of these alkali fluorides, and of binary mixtures of UF_4, ThF_4, YF_3, LaF_3, and CeF_3 with each of the alkali fluorides were measured as functions of the melt composition and temperature. Molar volumes at 1000°C were calculated for all the mixtures. Binary systems containing LiF exhibited molar volume ideality. Binary fluoride systems containing either NaF or KF as the alkali fluoride exhibit positive deviations from molar volume additivity. However, molar volumes in the NaF–KF system are ideal. Author

N66-36045# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.

CHEMISTRY OF DECARBORANE–PHOSPHORUS COMPOUNDS. VI: PHOSPHINO-M-CARBORANES

Roy P. Alexander and Hansjuergen Schroeder Oct. 1965 8 p refs Submitted for Publication

(Contract Nonr-3395(00))

(TR-27; AD-622300) CFSTI: HC $1.00/MF $0.50

Reactions between m-$B_{10}H_{10}C_2Li_2$ and chlorophosphines were conducted, and the chemistry of the products obtained was investigated. No indication of a cyclic monomeric product was observed. In reacting two molar equivalents of PCl_3 and one molar equivalent of m-$B_{10}H_{10}C_2Li_2$ m-$B_{10}H_{10}C_2$ (PCl_2) was obtained in 40% yield only, together with a product the consistency of which varied between highly viscous and brittle from run to run. Treatment of this by-product with methanol produced a polymeric solid. When the same reactants were combined in a 1:1 molar ratio, still some m-$B_{10}H_{10}C_2$ $(PCl_2)_2$ was obtained. Although the yield of polymeric product increased, the chain length remained unchanged. Reaction of the analogous m-$B_{10}H_9BrC_2Li_2$ with PCl_3 did not afford the noncyclic monomer but a pasty

product from which an oligomer was obtained by treatment with methanol. From these results it appears that this type of reaction leads only to polymeric products of limited molecular weight. These polymers consisting of a number of phosphorus-linked m-carborane nuclei are believed to be linear since they resemble metal-linked poly-m-carboranes of established chain structure. Author (TAB)

N66-36051*# Massachusetts Inst. of Tech., Cambridge.
THE DETECTION AND IDENTIFICATION OF ORGANIC MATTER BY MASS SPECTROMETRY Technical Progress Report, 16 Jun. 1965–15 Jun. 1966
[1966] 18 p refs
(Grant NsG-211-62)
(NASA-CR-77873) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Instrumentation was designed, and procedures were developed for obtaining the mass spectra of trace quantities of organic compounds. Computer techniques for treating and interpreting the data were also developed. The procedures are used for detecting and characterizing traces of organic compounds in terrestrial and extraterrestrial (meteorites) materials. The mass spectrum of an ionized non-carbonaceous chondrite (Holbrook meteorite) sample was examined in terms of the elemental composition of the ions formed between 25°C and 153°C. The experiment reveals the presence of a variety of organic compounds in a material previously thought to contain none at all. Other experimental procedures are also described, including one which utilizes a gas chromatographic column for separation. L.S.

N66-36063*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
ABUNDANCES OF TRACE ELEMENTS Na, Sc, Cr, Mn, Fe, Co, AND Cu IN CHONDRULES AND METEORITES; IN METEORITES AND TERRESTRIAL MATTER; AND U IN TYPE I CARBONACEOUS CHONDRITES Quarterly Progress Report, 1 Mar.–15 Jun. 1966
R. A. Schmitt 15 Jul. 1966 41 p refs
(Contract NASw-843)
(NASA-CR-77809; GA-7223) CFSTI: HC $2.00/MF $0.50 CSCL 07B

Abundances of the elements Na, Sc, Cr, Mn, Fe, Co, and Cu in 20 individual chondrules separated from the unequilibrated Weston chondrite, and 20 individual chondrules from the unequilibrated Tennasilm chondrite, were determined by instrumental neutron activation analysis NAA. The abundance data obtained are given in a table. Tabulated data are also given for radiochemical NAA in which the indium abundances in some 12 meteorites and 10 terrestrial specimens were investigated. These data supplement indium abundance data in samples of meteorites and terrestrial specimens previously determined. The abundances are also compared with other major elements in the third group of the periodic table. In addition, the abundance of U in two different Type I carbonaceous chondrites, Orgueil and Ivuna were determined by radiochemical NAA. The experimental details are given, and the results of the beta- and gamma-ray counting are tabulated and discussed. L.S.

N66-36136*# National Aeronautics and Space Administration, Washington, D. C.
ADSORPTION OF BARIUM ATOMS AND BARIUM OXIDE MOLECULES ON TUNGSTEN, II [ABSORBTSIYA ATOMIV BARIYU I MOLEKUL OKISU BARIYU NA VOL'FRAMI, II]
V. M. Gavrilyuk Aug. 1966 32 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 4, no. 6, 1959 p 734–749
(NASA-TT-F-10275) CFSTI: HC $2.00/MF $0.50 CSCL 07D

A theory of the interaction of atoms adsorbed on a metal surface is constructed. The relationship of the tungsten work function, calculated by means of this theory, to the degree of covering $\Delta\phi(\beta)$ by its adsorbed atoms and the change in heat of adsorption are in good agreement with those experimentally measured for Ba–W and Cs–W systems. A criterion is formulated for determining the number of adsorbed atoms in the monolayer. Author

N66-36145# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
INFLUENCE OF REPETITIVE ELECTROLYSIS ON WINNING MOLYBDENUM
Harold J. Heinen and Don Hobart Baker, Jr. 1966 19 p refs
(BM-RI-6834)

Repetitive batch electrowinning of molybdenum from molybdic oxide was studied to determine the effects upon the electrolyte life, purity of metal product, and overall cell performance. The electrolyte consisted of 54.0 wt% $Na_2B_4O_7$, 23.6 wt% NaCl, 14.9 wt% NaF, and 7.5 wt% MoO_3. The feed materials were pure and technical-grade MoO_3. Electrolysis was conducted at 1000°C in a graphite cell in an atmosphere of air and carbon oxides. Electrolyte degradation did not occur during repetitive winning of molybdenum from pure MoO_3 in an 8-day period of operation. Electrowon metal contained <0.1 percent total impurities. The electrode configuration is a key factor in the direct conversion of technical-grade MoO_3 to metal by repetitive cyclic electrolysis. The best configuration found was a cathodic crucible and a central anode. Metal purity of 99.8% and a current efficiency of 91% were maintained until the combined impurity buildup in the electrolyte reached 4.7% silicon, 1.0% aluminum, and 0.6% iron. One pound of molybdenum was produced per 1.5 pounds of solvent salts employed. About 25% of the initial NaCl and NaF contents of the electrolyte were lost owing to volatilization and crucible penetration. Author

N66-36147# Eidgenossische Technische Hochschule, Zurich (Switzerland).
INVESTIGATION OF THE PROBLEM OF A GENERAL RELATION BETWEEN STAUDINGER INDICES AND MOLECULAR WEIGHT [UNTERSUCHUNG ZUM PROBLEM EINER ALLGEMEINEN BEZIEHUNG ZWISCHEN STAUDINGER-INDICES UND MOLEKULARGEWICHTEN]
Fadel Ibrahim (Ph.D. Thesis) 1965 124 p refs In GERMAN
(Rept.-3640) CFSTI: HC $4.00/MF $1.00

The relationship between viscosity measurements and molecular weight of polymers was analyzed by computer evaluation of molecular spectra, viscosity measurements, and precipitation-titration values. It was concluded that differences between theta-dimensions and unperturbed dimensions of the solvent agent lead to fluctuations in cohesion energy density and dielectric constant values. Transl. by G.G.

N66-36148# Eidgenossische Technische Hochschule, Zurich (Switzerland).
ON THE MANUFACTURE OF SODA LIME AND ITS BEHAVIOR AS A CARBON DIOXIDE ABSORBENT [UEBER DIE HERSTELLUNG VON NATRONKALK UND SEIN VERHALTEN ALS KOHLENDIOXIDABSORBENS]
Kaspar Stoessel (Ph.D. Thesis) 1965 122 p refs In GERMAN
(Rept.-3689) CFSTI: HC $4.00/MF $1.00

Carbon dioxide absorption by soda lime in static and dynamic systems was analyzed with emphasis on saturation capacity and structural penetration possibilities. Chemical compositions, production methods, structural layouts, and absorption capability of soda lime filters were discussed. Absorption tests with porous filter structures showed unsymmetric dynamic absorption zones in brief structural layers; long term absorptions were observed at low flow velocities on

large structural layers with a stationary penetration pattern. The observed linear dependency of gas flow velocity and dynamic saturation point values was then used to develop theoretical methods for absorbing filter structure calculations. The water content in soda lime evolved as the determining quality factor for absorption capability and mechanical properties of porous lime filters. Transl. by G.G.

N66-36149# Eidgenossische Technische Hochschule, Zurich (Switzerland).

ON THE INFLUENCE OF THE EMULSIFIER CONSTITUTION ON THE PROPERTIES OF POLYVINYLCHLORIDE [UEBER DEN EINFLUSS DER EMULGATORKONSTITUTION AUF DIE EIGENSCHAFTEN VON POLYVINYLCHLORID]

István Fákla (Ph.D. Thesis) 1965 93 p refs In GERMAN (Rept.-3584) CFSTI: HC $3.00/MF $0.75

The influence of various emulsifiers on the polymerization of vinyl chloride was studied by evaluating the different polymerization processes and their respective durations, the yield in polyvinyl chloride, and the molecular weight and deformation point of the obtained polymers. The highest molecular weights were obtained with the sodium salts of paraffin-based sulfates having molecular chains of 10 to 18 carbon atoms; sodium salts of fatty acids with chains of 10 to 18 carbon atoms proved also efficient in vinyl chloride polymerization. Double bonds in paraffin chains generally slowed the polymerization process down and the retarding action was proportional to the number of double bonds present in the chain. Polyglycol ester and polyglycol ether proved less efficient as anion activating emulsifiers. Transl. by G.G.

N66-36155# Eidgenossische Technische Hochschule, Zurich (Switzerland).

CONTROLLING BLEACHING PROCESSES [ZUR KONTROLLE VON BLEICHPROZESSEN]

Karlheinz Laube (Ph.D. Thesis) 1965 114 p refs In GERMAN (Rept.-3717) CFSTI: HC $4.00/MF $0.75

Studied were diverse oxidation agents and bleaching processes that remove wood fibers and other impurities from cotton thread without damage to the cellular structure. Discussed control methods for cotton bleaching processes include: (1) an iron tartrate (EWNN) solvent for the determination of the average polymerization degree and oxygen attack on cotton fibers; (2) a methylene blue reaction for the correct determination of carboxyl groups; (3) a modified thiosemicarbazide reaction for carbonyl group analyses; and (4) potentiometric titration analyses for continuous control of bleaching agent concentration. Included is also a complete example analysis for bleached cotton fibers that defines the bleached product chemically and can be used as production control method in manufacturing processes. Transl. by G.G.

N66-36184# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

PREPARATION OF SUBMICRON TUNGSTEN POWDER BY HYDROGEN REDUCTION OF TUNGSTEN HEXACHLORIDE

Jack E. Tress, Thomas T. Campbell, and Frank E. Block 1966 22 p refs

(BM-RI-6835)

Submicron tungsten powder was prepared by reducing tungsten hexachloride with hydrogen. The particle diameters of the resulting tungsten powders ranged from 0.015 to 0.046 micron. Within the limits of the variables investigated, no clear-cut correlation was found between process conditions and final size of the powder. Oxygen was the major contaminant in the product, being present both as an adsorbed gas and as suboxides of tungsten. Studies showed that the powder yielded compacts of approximately 45 percent of theoretical density when compacted mechanically. Low temperature sintering produced more rapid densification in these compacts than in compacts prepared from conventional powders. Adding up to 20 percent ultrafine powder to conventional tungsten powder caused an increase in density upon compaction with maximum densification occurring at approximately 12 percent ultrafine powder. Author

N66-36189# California Univ., Livermore. Lawrence Radiation Lab.

PHYSICAL CHEMISTRY OF PROTACTINIUM

Robert Guillaumont Jul. 1965 30 p refs Transl. into ENGLISH from Colloq. Intern. Centre Nat. Recherche Sci. (Paris), no. 154, 2-8 Jul. 1965 p 1-14

(UCRL-TRANS-1244(L))

The distribution of penta- and tetravalent protactinium between various aqueous solutions complexing and or not complexing and benzene solutions of thenoyltrifluoroacetone was studied. The distribution coefficient was measured as a function of the concentration of chelating agent in the organic phase, as a function of the acidity and concentration of complexing anions in the aqueous phase and also as a function of protactinium. At tracer levels, Pa(V) is present as two ionic species in equilibrium $(PaPOH)^{3+}$ (or $PaO(OH)^{2+}$) and $Pa(OH)_4^+$ (or $PaO(OH)^{2+}$ or PaO_2^+ in the medium $[H^+] = x\underline{N}[Li^+] = (3-x)\underline{N}\,[ClO_4^-] = 3\underline{N}$. In 3N $HClO_4$ solution, the monomeric ion corresponding to the tetravalent state is Pa^{4+}. When $[H^+]$ decreases the species $Pa(OH)_n^{(4-n)+}$ with n=1,2, and 3, appear successively. When the protactinium concentration increases $Pa(OH)_3^{3+}$ is not polymerized in contrast to $Pa(OH)_4^+$. In 3N $HClO_4$ medium tetravalent protactinium is present as dimer or trimer species when Pa concentration reaches 10^{-5}M. The hydrolysis constants of the cations $Pa(OH)_3^{3+}$ and Pa^{4+} were calculated as well as the partial constant polymerization of the $Pa(OH)_4^+$ ion. The formulas and formation constants of the first complexes of Pa(V) and Pa(IV) which appear in solution of carrier free ^{233}Pa at ionic strength 3 in presence of Cl^-, SO_4^{2-}, $C_2O_4^{2-}$, and F^- were determined. NSA

N66-36194# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

GRAPHITE CHEMISTRY UK Research Newsletter

J. Wright Jun. 1965 18 p refs

(UK-RN-GC-A6)

Graphite—oxidation properties of; Graphite—oxidation of neutron-irradiated, kinetics of; Oxygen—reactions with neutron-irradiated graphite, kinetics of; Graphite—permeability properties of; Gases—permeability in graphite; Graphite—fabrication of, process development for; Graphite—reactions with carbon dioxide, evaluation of radio-induced; Carbon Dioxides—reactions with graphite, evaluation of radio-induced; Carbon-14—transfer between carbon dioxide and graphite, evaluation of radio-induced; Graphite—desorption of iodine, effects of oxidation rates on; Iodine—desorption from charcoal, effects of oxidation rates on; Air—effects on iodine desorption rates from charcoal; Carbon Dioxides—effects on iodine desorption rates from charcoal; Methane, Iodo—desorption from charcoal, effects of oxidation rates on; Gases—radiation effects on sorption of, by graphite; Gases—reactions with graphite, evaluation of radio-induced; Graphite—radiation effects on sorptive properties for gases; Graphite—reactions with gases, evaluation of radio-induced; Carbon Monoxides—radiolysis of, proton; Protons—radiolysis of carbon monoxides. NSA

N66-36208# Washington Univ., Seattle. Dept. of Chemistry.

THE REACTION OF PEROXYDISULFURYL DIFLUORIDE WITH ANTIMONY PENTACHLORIDE

Ronald E. Noftle and George H. Cady 1966 12 p refs
(Contract Nonr-477(16); ARPA Order 26-60)
(TR-55; AD-634881) CFSTI: HC $1.00/MF $0.50

The reaction of $S_2O_6F_2$ with $SbCl_5$ proceeded readily in the vicinity of 3°C. In reactions involving a mole ratio of $S_2O_6F_2$:$SbCl_5$ slightly in excess of 2.5:1, an unstable antimony fluorosulfate was formed. This viscous orange liquid contained at least 4 fluorosulfate groups per atom of Sb. The substance slowly decomposed at 25°C in vacuo liberating $S_2O_5F_2$ and SO_3. The orange oil was pumped to constant weight at 25°C, and the non-volatile material which remained was a pale yellow solid. The pale yellow solid was found to contain a small amount of chlorine present in a positive oxidation state. In the case of reactions involving a large excess of $S_2O_6F_2$, the results indicated that a stable antimony compound containing close to 3.5 fluorosulfate groups per atom of antimony was formed. Again chlorine was found to be present in a positive oxidation state, and it is possible that stabilization of the antimony compound occurred through partial formation of a complex $R^+[Sb(SO_3F)_{6-x}F_x]^-$ where R= Cl, ClO, or ClO_2. Author (TAB)

N66-36214# Peninsular ChemResearch, Inc., Gainesville, Fla.

SYNTHESIS AND POLYMERIZATION OF FLUORINATED SULFUR MODIFIED NITROSO RUBBER Quarterly Report, 26 Nov. 1965–26 Feb. 1966

Eugene C. Stump, Calvin D. Padgett, and Charles R. Wetzel 26 Mar. 1966 32 p refs *Its* Rept.-66-52-CM
(Contract DA-19-129-AMC-152(N))
(QR-10; AD-634728) CFSTI: HC $2.00/MF $0.50

Tetrafluoroallene was prepared and terpolymerized with $CF_3NO/CF_2=CF_2$. Additional samples of methyl γ-nitrosoperfluorobutyrate were prepared and polymerized with $CF_3NO/CF_2=CF_2$. Several unsuccessful attempts were made to crosslink terpolymers containing $CF_2=CFBr$, $CF_2=CFCF=CF_2$, C_6F_5NO, $CF_2=C=CF_2$ and $CF_2=CFCH=CH_2$. A low temperature polymerization unit was installed and is now in operation. Author (TAB)

N66-36237# Carnegie Inst. of Tech., Pittsburgh, Pa.

"HOT" RADICAL REACTIONS IN FLASH PHOTOLYSIS Final Annual Report

Gilbert J. Mains 25 Apr. 1966 94 p refs
(Grant AF-AFOSR-513-64)
(AFOSR-66-0727; AD-632463) CFSTI: HC $3.00/MF $0.75

The flash photolysis of hydrogen iodide in the presence of perdeutero-hydrocarbons was found to yield H_2 and HD. The results were subjected to kinetic analysis. The effects of inert gas moderators were studied obtaining an indication of the extent to which non-reactive collisions between hot hydrogen atoms and these hydrocarbons are inelastic. The results obtained are consistent with those obtained in low intensity studies. The $Hg(^3P_1)$ photosensitized decomposition of GeH_4 appears to proceed by rupture of a G_e—H bond. The H atoms formed in the primary process were found to be unscavengeable by 5% added propylene. It is proposed that the abstraction reaction, $H+GeH_4 \rightarrow H_2+GeH_3$, is very rapid and/or that the hydrogen atoms formed in the primary process carry some of the excess energy of the reaction. The rapid consumption of higher hydrides of germanium is partly attributed to their reactions with germyl radicals. The flash photolysis of methyl iodide was found to yield methane, ethane, ethylene, acetylene and iodine. The major mechanism of methane formation changes from low to high intensity increasing the quantum yield for methane production from 0.02 to 0.15. Author (TAB)

N66-36249# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.

GUIDE FOR ACTIVATION ANALYSIS AT THE UNIVERSITY OF FLORIDA

Louis G. Grant Jun. 1966 40 p refs *Its* Eng. Progr. at the Univ. of Fla., v. 20, no. 6 *Its* Bull. No. 124

The basic principles of analytical neutron activation methods are discussed and proposed applications are outlined with emphasis on the capability of the University of Florida training reactor. Tables list the minimum amounts of elements that can be determined by using this reactor for activation analyses. G.G.

N66-36255# Eidgenossisches Technische Hochschule, Zurich (Switzerland).

INVESTIGATION OF SYNTHESIS AND CHARACTERIZATION DEFINED BY COMPLEX POLYAETHYLENOXIDE [UNTERSUCHUNGEN ZUR SYNTHESE UND CHARAKTERISIERUNG DEFINIERT VERZWEIGTER POLYAETHYLENOXIDE]

Hans-Peter Lys (Ph.D. Thesis) 1965 126 p refs In GERMAN
(Rept.-3694) CFSTI: HC $3.00/MF $1.00

The synthesis of macromolecules with one branching point and three equally long chains for each molecule was studied on model polymers that allowed a final decomposition of the branched molecules into the original compound. The polyethylene glycol monomethylether was chosen as basic polymer and a trimesic acid chloride was used to obtain a multiple chain polymer. Theoretical minimum curves for the concentration dependency of reciprocal molecular weights in associated substances were confirmed by experiments that analyzed the influence of terminal group members on the solution ability of polyethylene oxides. Molecular weight measurements on the dependency of the second virial coefficient were used to form a model for soluble states of polyethylene glycoles in methane and in dimethyl formamide. This model connected helix forms about 14 basic blocks with chains. Transl. by G.G.

N66-36256# Eidgenossisches Technische Hochschule, Zurich (Switzerland).

INVESTIGATION INTO THE PREPARATION OF 4-DEOXY SUGAR OUT OF D-GALACTURONIC ACID [UNTERSUCHUNGEN ZUR DARSTELLUNG VON 4-DESOXYZUCKERN AUS D-GALAKTURONSAEURE]

Harold Schmidt (Ph.D. Thesis) 1965 99 p refs
(Rept.-3597) CFSTI: HC $3.00/MF $0.75

The synthesis of 4-desoxy-saccharide through preparation of a 4,5-unsaturated galacturonic acid derivative (12,13) is described. From D-galacturonic acid was a methyl-D-galacturonopyrano-methyl ester compound obtained; the corresponding 4,5-unsaturated compounds of 4-desoxyuronic acid derivatives were then de-estered and underwent subsequent hydrolysis for 4-desoxyhexoses. Transl. by G.G.

N66-36257# Eidgenossisches Technische Hochschule, Zurich (Switzerland).

ON PHYSICAL TOXICITY AND ADSORPTION CHARACTERISTICS OF SOLID CATALYSTS [UEBER PHYSIKALISCHE VERGIFTUNG UND ADSORPTIONSEIGENSCHAFTEN VON FESTOFFKATALYSATOREN]

Peter Georg Grimm (Ph.D. Thesis) 1965 105 p refs In GERMAN
(Rept.-3748) CFSTI: HC $3.00/MF $0.75

Physical inhibition in two catalytic reactions, namely the hydration of benzene to cyclohexane and the dehydration of ethyl alcohol, was studied by measuring the adsorption capability of the catalyst in the presence of decalin, i-octane,

cyclohexane, and n-hexanes. Reaction velocity constants of the catalytic processes correlated with the adsorption ability of the catalytic systems involved and were governed by the adsorption equilibrium. Reaction velocity during benzene hydration was proportional to the educted layer on the surface of the catalyst; the educted products themselves produced a slowdown effect on the catalytic process during ethyl alcohol dehydration. Transl. by G.G

N66-36350# Eidgenossische Technische Hochschule, Zurich (Switzerland).

PRECISION MEASUREMENT AND SIMULTANEOUS DETERMINATION OF ^{3}H AND ^{14}C IN THE PROPORTIONAL TUBE COUNTER [PRAEZISIONSMESSUNG UND GLEICHZEITIGE BESTIMMUNG VON ^{3}H UND ^{14}C IM GAS-PROPORTIONALZAEHLROHR]

Philippe Achille Lykouriezos (Ph.D. Thesis) 1965 71 p refs In GERMAN
(Rept.-3676) CFSTI: HC $3.00/MF $0.75

The various parameters that influence the exact determination of hydrogen and carbon isotopes in proportional gas discharge counters were discussed, and a graphic method was developed that showed the observed radioactive pulse rates as sensitivity functions for connected amplifiers. Corresponding impulse spectra were compared by graphic discrimination curves and possessed an error factor of only about 0.1 to 0.3%. This method made it also possible to measure the hydrogen and carbon isotopes at the same time. Transl. by G.G.

N66-36380# Eidgenossische Technische Hochschule, Zurich (Switzerland).

RESEARCH OF A SALT DECOMPOSITION IN LIQUID AMMONIA [UNTERSUCHUNG EINIGER SALZUMSETZUNGEN IN FLUESSIGEM AMMONIAK]

John Kummer (Ph.D. Thesis) 1965 87 p refs In GERMAN (Rept.-3690) CFSTI: HC $3.00/MF $0.75

Investigated were inorganic reactions in liquid ammonia that formed hydrated products which needed further calcination, or undesirable aqueous solutions, or products that underwent hydrolysis in aqueous solutions. The direct manufacturing of sodium tetraborate by nitration in liquid ammonia, or by dehydration with liquid ammonia was evaluated; a repeated dehydration process followed by rapid heating to 450°C gave a fine, water-free sodium tetraborate powder. The transformation of ammonium chloride with calcium nitrate to ammonium nitrate in a liquid ammonia solution was not successful since the obtained product contained calcium chloride impurities. The conversion of carbon dioxide with potassium nitrate to potassium carbamate in a liquid ammonia solution resulted in a 100% yield when an excess of potassium nitrate was utilized. Transl. by G.G.

N66-36385# Eidgenossische Technische Hochschule, Zurich (Switzerland).

INFORMATION ON THE REACTION BETWEEN POLYVINYLALCOHOL AND SIX VALENCE CHROMIUM WITH SPECIAL CONSIDERATION TO THE REACTION IN PHOTOSENSITIVE LAYERS [ZUR KENNTNIS DER REAKTION ZWISCHEN POLYVINYLALKOHOL UND SECHSWERTIGEM CHROM UNTER BESONDERER BERUECKSICHTIGUNG DER REAKTION IN LICHTEMPFINDLICHEN SCHICHTEN]

Kurt Schlaepfer (Ph.D. Thesis) 1965 36 p refs Repr. from Schweiz. Arch. Angew. Wiss. Tech. (Solothurn, Switzerland), v. 5, 1965 In GERMAN
(Rept.-3582)

The reactions between polyvinyl alcohol (PVA) and chromium functioning with a valence of six were studied with emphasis on the light sensitivity characteristics of PVA–ammonium–bichromate layers for photoreproduction purposes. Oxidation products from this reaction were characterized by a number of disassociated C-C bonds. Viscosity and osmotic measurements showed that the amount of the disassociated C-C bonds depended on oxidation conditions; oxidation in neutral solutions under light stimulation produced less disassociated C-C bonds than oxidation in acid solutions. Analyses of various illuminated PVA solutions showed that light stimulation was highest near the pH value of ammonium carbonate. The light sensitivity of the PVA layers increased with their molecular weight and the saponification factor of the utilized PVA type. PVA layers with a molecular weight below 15,000 or above 90,000 were not suitable for light sensitive application because their too high, respectively too low, molecular weight structure resulted in unclear reproductions. Transl. by G.G.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-35355# Air Force Cambridge Research Labs., Bedford, Mass.

VHF–HF OMNIDIRECTIONAL BALLOON LOCATING SYSTEM

John H. Crummie *In its* Proc. AFCRL Sci. Balloon Workshop, 1965 May 1966 p 97–102 (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

The design, development, and testing of an experimental Balloon Locating System and a proposed operational Balloon Locating System are presented. This presentation includes the following phases of the Locating System: VOR Theory, Encoding and HF Telemetry Technique, Flight Test Results, a New Airborne Unit, and a New Plotting Method. Author

N66-36379# Joint Publications Research Service, Washington, D. C.

ONE METHOD OF REALIZATION OF WIDE-BAND 90° PHASE SHIFT NETWORKS

Jun-Sheng Wang, Chun-P'ei Hsieh, T'sui Hsuen, and I-Chen Hsue *In its* Transl. of Communist China: Sci. and Technol., No. 337 19 Aug. 1966 p 20–30 refs Transl. into ENGLISH from Tien-Tzu Hsueh-Pao (Peking), no. 1, Mar. 1966 p 3–10 (See N66-35377 21-34) CFSTI: $2.00

In this paper, one method of realization of wide-band 90° phase shift networks is discussed. When this method being applied, not only the wide-band 90° phase shift is realized, but also a constant time delay of the signal can be obtained, hence it is especially suitable to be used in the high peed digital communication systems with differentially PSK. A practical example of application of this method and the result of experiments are given. Author

N66-36380# Joint Publications Research Service, Washington, D. C.

THE REALIZATION OF THE CODING PULSE COMPRESSION WITH MULTIPLE-TAPPED DELAY LINES

Chi-Chung Fu and Mo-Li Wang *In its* Transl. on Communist China: Sci. and Technol., No. 337 19 Aug. 1966 p 31–42 refs Transl. into ENGLISH from Tien-Tzu Hsueh-Pao (Peking), no. 1, Mar. 1966 p 26–33 (See N66-35377 21-34) CFSTI: $2.00

The principle of forming an approximately matched filter with the multiple-tapped delay line system to realize the coding pulse compression is briefly described. Experiments on M sequence (N=63) coding pulse compression are given. The compression ratio of the model obtained at the laboratory is 1.2db, less than the theoretical value. As to the compressed waveform, the ratio of the main lobe to the largest side-lobe is 8 db less than that given by the theory. Some problems met with in the course of the experiments are discussed in brief. Author

N66-35476# Army Missile Command, Huntsville, Ala. Technical Assistance Div.

BASIC AND ADVANCED INFRARED TECHNOLOGY

15 Apr. 1965 182 p refs

(AD-634535) CFSTI: HC $5.00/MF $1.00

The primary purpose of this course is to provide the missile maintenance technician with the basic fundamentals of infrared technology. As of now, the published results on infrared are widely scattered and are often relatively inaccesible and expressed in highly technical language, perhaps understood only by specialists in this field. It is intended that this text will alleviate this condition, as an attempt was made to state the infrared principles as simply and straightforwardly as possible and without detailed argument. TAB

N66-35482# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

A PORTABLE SIGNAL SIMULATOR AND DECOMMUTATOR FOR PULSE POSITION MODULATION TELEMETRY

J. Leon Poirier May 1966 30 p refs *Its* Instrumentation Papers No. 96

(AFCRL-66-315; AD-635105) CFSTI: HC $2.00/MF $0.50

This report describes the operation of a pulse position modulation telemetry signal simulator and a decommutator that are used for testing and calibrating payloads for Trailblazer II vehicles. The simulator generates dual polarity Pulse Duration Modulation or Pulse Position Modulation modulating signals of several widths. The decommutator performs the functions of decommutation, PPM to PDM conversion, and frame-synchronization signal generation. The units are designed to operate at the standard commutation rate of 900 samples per second with a frame rate of 20 frames per second. Author (TAB)

N66-35488# National Observatory of Athens (Greece). Ionospheric Inst.

SOLAR RADIO EMISSION. RADIO NOISE MEASUREMENTS

Michael Anastassiades *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 165–169 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Solar radio noise measurements recorded at the Penteli Station in Athens, Greece from October through December 1965 are presented in tabular form. R.N.A.

N66-35499# Air Force Cambridge Research Labs., Bedford, Mass.

SOLAR RADIO EMISSION. RADIO NOISE MEASUREMENTS

John P. Castelli *In its* Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 171–177 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Solar radio noise measurements made at 606, 1415, 2700, 5000, and 8800 MHz and recorded by the Sagamore Hill Radio Observatory situated in Hamilton, Massachusetts during the period 1 October to 31 December 1965 are listed. A graph showing a major solar event in progress at 606 MHz on October 4, 1965 is included. R.N.A.

N66-35500# Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.

SOLAR RADIO EMISSION. RADIO NOISE MEASUREMENTS

S. Rosseland *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 179–193 ref (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Solar radio noise observations made by the Oslo Solar Observatory located in Narestua, Norway during 1964 and 1965 are tabulated. The tables include median flux density, variability, and outstanding occurrences. The method used in tabulating the solar radio noise data and the observation time are briefly discussed. R.N.A.

N66-35541# Army Electronics Labs., Fort Monmouth, N. J.

ON THE RELATION OF IONOSPHERIC DOPPLER SHIFT, PHASE VELOCITY, AND INTEGRATED ELECTRON CONTENT

P. R. Arendt Jun. 1966 34 p refs

(ECOM-2724; AD-635380) CFSTI: HC $2.00/MF $0.50

Difficulties are discussed which are inherent with unlimited use of the differential doppler method for satellite measurements. For precision, restriction is recommended to overhead passages and to closely related frequencies. The restriction applies to measurements of the ionospheric electron content, finding of geodetic positions, and to hybrid methods combining polarization and frequency measurements. Author (TAB)

N66-35550*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A NEW PERFORMANCE CRITERION FOR LINEAR FILTERS WITH RANDOM INPUTS

Mario H. Rheinfurth *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 34–51 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

A performance criterion is introduced for linear statistical filters. Because of its physical significance, it represents a welcome complement to Wiener's performance criterion, and provides for greater flexibility in the design of optimal filters. Application to several typical filter problems reveals its remarkable mathematical simplicity promoting an intuitive physical understanding of its essential features. Another important advantage of the performance criterion is its applicability to problems involving periodic signals, which affords an interesting comparison with other available filter techniques. The full potential and limitations of the new performance criterion, however, can only be judiciously assessed by further extensive studies. Author

N66-35558*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ANALYSIS OF THE INFLUENCE OF VENTING AND GAS LEAKAGE ON TRACKING OF ORBITAL VEHICLES

A. R. Mc Nair and P. E. Dreher *In its* Aero-Astrondyn. Res. Rev. No. 2 1 Apr. 1965 p 140–147 ref (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

The results of a study of the effects on earth orbits of leakage and venting of propellant gases are discussed. Two types of propulsive thrusts, continuous and intermittent, which might result from such venting and leakage, are treated considering the orbit and tracking effects. Integrated and analytic formulations were made. Author

N66-35559# Communication Systems, Inc., Paramus, N. J.

FUTURE AIR-GROUND-AIR COMMUNICATION SUBSYSTEM INVESTIGATION, PART J, APPENDICES V THRU XIV, VOLUME VI Final Report

Jul. 1966 284 p refs
(Contract FA-WA-4645)
(CSI-66-TR-2149; RD-66-16, Vol. VI)

A sample of air and communication traffic data was taken from normally busy terminal and enroute controller positions in the FAA Eastern Region during selected heavy traffic periods. The raw data, taken from flight strips and communication tapes, was reduced by a computer program. An analysis identified significant relations between air traffic and communication traffic. The impact on communication traffic of other ATC environmental factors was also studied. Based on this analysis and on best available predictions of the future ATC environment and air traffic, post 1972 A/G/A communication traffic demands were projected. A communication subsystem capable of supporting this traffic and satisfying other requirements of future ATC A/G/A communications was synthesized. The necessary hardware is within the state of the art, but for the most part still requires development. A feasible, phased implementation plan for the development and introduction of the future subsystem is presented, together with preliminary budgetary cost estimates for the program. Author

N66-35577# National Engineering Science Co., Houston, Tex.
STATISTICAL PROPERTIES OF RADAR ECHO PATTERNS AND THE RADAR ECHO PROCESS
Larry Armijo *In its* Statist. Properties of Radar Echo Patterns and the Radar Echo Process. The Role of the Kutta–Joukowski Force in Cloud Systems with Circulation Jun. 1966 p 1–19 refs (See N66-35576 21-20)

A stochastic process for explaining the statistical properties of radar echo patterns in a given direction is defined and investigated. We call this the radar echo process. Earlier work by Kessler, Russo and Cole, who used the random telegraph process as a model for the statistical properties of radar echo patterns, led to certain discrepancies. The radar echo process is a much more satisfactory model for these statistical properties and completely explains the discrepancies due to the random telegraph assumption. The new process, being coverage dependent, reduces to the random telegraph process for fifty percent coverage, is wide sense stationary and ergodic, has an exponential normalized autocorrelation function, implies realistic distributions of lengths, and is formulated in terms of conditional probabilities which are explicitly expressible in terms of elementary functions. Author

N66-35589*# Kyoto Univ. (Japan). Dept. of Engineering.
SPACE RADIO PATROL
Ken'ichi Maeda and Tatsuzo Obayashi In NASA, Washington Environ. Testing of Satellite-Borne Instr. Space Radio Patrol Jan. 1964 p 6–14 (See N66-35587 21-14) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Radio research in the United States' satellite program is discussed, with observations collected in 1963 tabulated and methods employed in cosmic radio noise studies considered. Specific attention is given to the antenna and telemetry for use in space radio patrol projects. A whip antenna with a loop is suggested for use at frequencies of 1, 3, 10, and 30 kc; a loop antenna with a whip supplement for 100 and 300 kc observations; and a loop antenna for observations at 1000 and 3000 kc. M.W.R.

N66-35646# Singer Co., Bridgeport, Conn. Metrics Div.
FREQUENCY CONVERTER CV-(TX)-URM-85 Final Report
Markus Epstein Jun. 1966 28 p refs
(Contract DA-36-039-AMC-00125(E))
(ECOM-00125-F; AD-635208) CFSTI: HC $2.00/MF $0.50

The aim of this final report is to discuss the results of the investigation, analysis, and design techniques used in developing the frequency converter CV-(TX)-URM-85, a 14 kc to 150 kc plug-in tuning unit, to extend the frequency range of the radio interference measuring set AN/URM-85. The tuning unit is mechanically and electrically compatible with the main unit of the AN/URM-85 which is known as receiver, radio 1040/URM-85. Each special design consideration or problem is presented along with conclusions and recommendations. Test results relating frequency, gain and bandwidth stability vs. temperature are presented. TAB

N66-35686*# National Aeronautics and Space Administration, Washington, D. C.
GUIDE TO THE SUBJECT INDEXES FOR SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS
Jul. 1966 471 p refs
(NASA-SP-7016, Rev. 3) CFSTI: HC $3.75/MF $2.50 CSCL 05B

The guide contains a listing of subject terms and cross references for use with the indexes to "Scientific and Technical Aerospace Reports", "Classified Scientific and Technical Aerospace Reports", "Aerospace Medicine and Biology", and "International Aerospace Abstracts". The subject terms are supplemented with cross references intended to enable a user to modify, enlarge, or narrow his search. N.E.N

N66-35791*# Ohio State Univ. Research Foundation, Columbus, Dept. of Electrical Engineering.
ACCURACY OF APPROXIMATE FORMULATIONS FOR NEAR-FIELD WEDGE DIFFRACTION OF A LINE SOURCE
L. L. Tsai and R. C. Rudduck 15 Mar. 1966 31 p refs *Its* Rept.-1691-18
(Grant NsG-448)
(NASA-CR-77651) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The accuracies of two approximate formulations which are used in edge diffraction theory are checked. The formulations apply for the near-field diffraction of a cylindrical wave by a wedge. The approximate formulations are compared with the exact solution which can be evaluated in the region where the approximations need to be checked. The approximate formulations are found to be accurate, with errors which are generally less than a few per cent. Author

N66-35945# Joint Publications Research Service, Washington, D. C.
ATTENUATION OF RADIATION FROM ARTIFICIAL EARTH SATELLITES IN ABOVE-SURFACE TRAJECTORIES
Sh. G. Shlionskiy 30 Aug. 1966 17 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 6, Nov.–Dec. 1965 p 1061–1067
(JPRS-37350; TT-66-33779)) CFSTI: $1.00

The transmission conditions of radiowaves in the ionosphere along over-surface (skipping) trajectories are considered using data on the structure of the medium and the global echo signals. Transmission of these waves cannot be explained by the usual mechanism of propagation with sequential reflection from the earth's surface and the ionosphere. Occurrence of the above-surface trajectories is increased with transmitters aboard artificial earth satellites. Associated questions concerning conditions for the occurrence of the above-surface trajectories are examined. The form of the above-surface trjaectories is determined by initial conditions such as the transmitter altitude and the variation of the medium structure along the path. Surface reception of satellite radiation traveling along the above-surface trajectory is possible only when the trajectory descends to the earth within the limits of the path. Determination of the attenuation requires account for its behavior and the structure of the medium along the path. S.P

N66-35983*# Rantec Corp., Calabasas, Calif.
15 Jun. 1966 87 p refs *Its* Rept.-31796-FRI
(Contract NAS5-3564)
(NASA-CR-77769) CFSTI: HC $2.50/MF $0.75 CSCL 09F

Engineering concepts and design problems involving the Cassegrain feed system installed on the Rosman 85-foot antenna are reported. The system is designed for reception in the 4.0 to 4.2 Gc band, and transmission in the 6.0 to 6.4 Gc band. While the system is primarily for the Advanced Technological Satellite mission, it can be used for Comsat and Relay satellites which operate in the same frequency band. Details of the system configuration are given, including a block diagram. Engineering design parameters for each of the major components are discussed. Emphasis is placed on electrical and mechanical requirements with coverage of the design milestones leading to the existence of hardware suitable for the requirements. The electrical performance characteristics are considered for radiation patterns, gain, and tracking. A description of a solid state, dual channel, phase lock receiver for polarization alignment of a Cassegrain feed system is appended. E.A.O.

N66-36008 American Telephone and Telegraph Co., New York.
CAPABILITIES OF BOUNDED DISCREPANCY DECODING
A. D. Wyner Repr. from Bell System Tech. J., v. 44, Jul.–Aug. 1965 p 1061–1122 *Its* Monograph No. 5038

The following four channels are considered: (a) a class of discrete memoryless channels with q inputs and outputs, (b) the time-discrete, amplitude-continuous memoryless channel with additive Gaussian noise and amplitude constraints, (c) the same as channel b but with energy instead of amplitude constraint, and (d) a class of time-discrete, amplitude-continuous memoryless channels with amplitude constraint and non-Gaussian noise. For each channel the theoretical capabilities of "bounded discrepancy decoding" are studied. The "discrepancy" between two vectors is a distance or distance-like quantity defined such that the optimal decoder is a "minimum discrepancy decoder." For all four classes of channels the following is shown to hold: There exists a fixed positive rate C_B below which it is possible (asymptotically in n) to obtain exponentially small error probability using bounded discrepancy decoding. In many cases C_B is shown to be strictly less than the channel capacity. Author

N66-36020# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
INCREASING THE EFFECTIVE APERTURE OF TWO-DIMENSIONAL ANTENNAS BY A LINEAR ANALYTIC CONTINUATION TECHNIQUE
M. R. Wohlers May 1966 24 p refs
(RM-326)

It is shown that the performance of a two-dimensional receiving antenna may be improved by proper processing of the output signals from the antenna. The mathematical technique employed in this processing is the analytic continuation of entire functions. A principal feature of the technique is that it is linear so that the resulting antenna system can be used to receive coherent signals without nonlinear distortions. Author

N66-36068# Naval Ordnance Lab., Corona, Calif. Research Dept.
EXPERIMENTAL EVALUATION OF SCORDES RESOLUTION CAPABILITIES
R. H. Espeland 18 May 1966 42 p refs
(NOLC-652; AD-483344)

The Sferics Correlation Detection System (SCORDES) is a VLF radar system that utilizes sferics (the electromagnetic radiation emitted by lightning discharges) as an energy source. This report presents an experimental evaluation of the SCORDES capabilities in determining range and bearing to targets. Patterns of resolution capability are given for targets of known size and location. Experimental data were derived from SCORDES operation in several frequency and bandwidth modes and with two types of reference sferics selectors. Author (TAB)

N66-36099*# Harvard Univ., Cambridge, Mass. Gordon Mc Kay Lab.
THE CYLINDRICAL ANTENNA WITH TAPERED RESISTIVE LOADING Scientific Report No. 5
Liang-Chi Shen and Tai Tsun Wu Aug. 1965 27 p refs Submitted for Publication
(Grant NsG-579)
(NASA-CR-68394) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The current, the input impedance and the far field pattern of a cylindrical antenna with resistive loading are determined. The distribution of the resistive loading along the antenna is a particular function multiplied by a constant positive parameter α. The current on the antenna and the field pattern are evaluated for a wide range of lengths with several different α's ranging from 0 to 1 and for positive integers. They are found not critically dependent on the parameter α. For α near or greater than 1, the antenna is nonreflecting. Author

N66-36224# Mitre Corp., Bedford, Mass.
OPTIMUM MESSAGE LENGTH FOR A DATA COMMUNICATIONS SYSTEM USING RETRANSMISSION ERROR CONTROL
Larry L. Stine Jun. 1966 41 p refs
(Contract AF 19(628)-5165)
(MTR-189; ESD-TR-66-110; AD-635462) CFSTI: HC $2.00/MF $0.50

In this report, a mathematical model of a data communications system using retransmission error control is developed. System performance is specified by information throughput, the amount of error-free data transferred per unit of time. Information throughput is determined as a function of message length, taking into account transmission delay, channel error rate, and overhead words in the data message. Author (TAB)

N66-36229# Harvard Univ., Cambridge, Mass. Cruft Lab.
NONLINEAR TRANSFORMATIONS OF RANDOM PROCESSES Interim Technical Report
Norman Abramson Apr. 1966 20 p refs
(Contract Nonr-1866(16))
(TR-497; AD-633048) CFSTI: HC $1.00/MF $0.50

This paper provides a general method of calculating the mean square bandwidth of an arbitrary zero-memory nonlinear transformation of a stationary random process. The method is valid when the original process is non-Gaussian as well as Gaussian and when the original process is an arbitrary combination of other random processes. It can be used to determine the mean square bandwidth of the transformed process either before or after that process is passed through a bandpass filter. Five examples of the application of this method are provided simplifying and generalizing known results, as well as providing new results. Author (TAB)

N66-36315*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TELEVISION SYSTEM
J. Denton Allen and L. Malling *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 58–67 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The TV system parameters, mechanization, and electronics are summarized. The shutter/filter assembly, telescope, and vidicon tube are described. The electronics, divided into the equipment associated with the camera head and the equipment mounted remotely in the main part of the spacecraft, are discussed. Typical performance photographs, and details on the time sequence of the photographing and transmission to Earth are included. N.E.N.

N66-36389*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

SOME EXPERIMENTAL RESULTS ON COMMUNICATION SYSTEMS SUBJECT TO INTERSYMBOL INTERFERENCE

C. C. Bailey Jul. 1966 15 p ref *Its* Mem. Rept.-66-1
(Grant NsG-553)
(NASA-CR-77944) CFSTI: HC $1.00/MF $0.50 CSCL 17B

An investigation was conducted of the degree to which intersymbol interference can be compensated for by the use of easily implemented phase correcting networks in digital communication systems. The degradation considered results from attempts to communicate at a rate which approaches or exceeds the reciprocal of the channel's correlation bandwidth. Results of the study show that a significant improvement in system performance can be achieved by using compensating networks composed of cascaded single pole all-pass sections. For instance, for a delay distortion factor of 1.5 (envelope delay at each end of the band is ±1.5 band lengths relative to the midband spectrum component) probability of error increases from 0.1 to 0.15 without the use of phase correction networks. A two section compensating network will result in only one-third as much degradation, while a five section compensating network virtually reduces the degradation to zero. C.T.C.

N66-36391*# California Computer Products, Inc., Anaheim.

MEDIUM RESOLUTION INFRA-RED (MRIR) EXPERIMENT ENGINEERING MODEL DIGITAL ELECTRONICS TELEMETRY UNIT FOR NIMBUS "B" Final Engineering Report, 1 Nov. 1965–1 Apr. 1966

[1966] 139 p refs
(Contract NAS5-9699)
(NASA-CR-77941; DO 301-014) CFSTI: HC $4.00/MF $1.00 CSCL 09F

A detailed description is given of the overall design aspects of the MRIR telemetry unit engineering model. Also, design information on the bench test equipment which was modified for the MRIR unit is presented. Information on the telemetry unit operation is established, engineering problems uncovered during functional testing are defined, and improvements to be incorporated into succeeding units are recommended. Sufficient data for maintenance purposes of the telemetry unit are included. C.T.C.

N66-36392# Japan Broadcasting Corp., Tokyo. NHK Technical Research Labs.

STACKED LOOP ANTENNA

Keiji Endo, Yukio Endo, and Hiroshi Okamura Jun. 1966 40 p refs
(S-7) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The present article describes the various characteristics of the stacked-loop antenna which has recently been developed for UHF television broadcasting application. This antenna consists of a number of one-wavelength loops and has the following features: (1) the number of feed points is small and the structure is simple, (2) this type antenna has high-gain and broadband characteristics. It is possible to use a single antenna simultaneously for several UHF television stations, and (3) it is possible to obtain any desired horizontal radiation pattern by its multi-element combination. Author

N66-36405*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

[THEORETICAL AND EXPERIMENTAL STUDIES OF SUB-OPTIMAL SECOND AND THIRD GENERATION SELF-ADAPTIVE BINARY COMMUNICATION SYSTEM] Semi-annual Report, Jan. 1–Jun. 30, 1966

John C. Lindenlaub and Clare D. Mc Gillem [1966] 27 p refs
(Grant NsG-553)
(NASA-CR-77936) CFSTI: HC $2.00/MF $0.50 CSCL 09F

Research summaries are presented of (1) experimental results on communication systems subject to intersymbol interference, (2) phase lock loop studies, (3) channel simulator studies, (4) optimum binary signal sets for scatter multi-path channel models, and (5) families of equal length shift register sequences obtainable from a new class of cyclic codes. In the intersymbol interference studies a digital computer simulation program was used to investigate the effects of channel-induced phase distortion, and to evaluate methods of reducing these effects. Performance improvements are emphasized in phase lock loop studies, with consideration given mainly to the tanlock system. A brief description is given of the channel simulator which consists of a water tank "channel" hydrophone "antennas", and electronic equipment necessary for signal generation and processing. In the optimum binary signal set area it is shown that an optimum binary signal set for a scatter multipath channel with random path delays is characterized by the property that the envelop for the cross correlation function has the smallest possible peak value. C.T.C.

N66-36417# British Broadcasting Corp., Kingswood (England). Research Dept.

A SERVO-CONTROLLED, ONE-LINE DELAY FOR 625-LINE TELEVISION SIGNALS

S. M. Edwardson, A. D. Stalley, and G. C. Wilkinson [1965] 19 p refs
(T-158) CFSTI: HC $1.00/MF $0.50

An apparatus is described that was designed to delay a mains-locked 625-line television signal by a period equal to the duration of one television scanning line. The equipment was designed primarily for use in a line-store standards converter but has other applications in television engineering. A fused-quartz ultrasonic delay is employed as the main delay element together with a variable video delay compensating automatically for small changes in the television line duration. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-36371# Johnson Service Co., Milwaukee, Wis. Research Div.

FLUERICS: 19: LOW-PRESSURE AMPLIFIER AND ANALOG COMPUTER Final Report, 1 Oct. 1964–30 Sep. 1965

Thomas J. Lechner Washington, Harry Diamond Labs., Apr. 1966 72 p refs
(Contract DA-49-186-AMC-126(D))
(AD-635227) CFSTI: HC $1.50/MF $0.75

The report describes the design and performance of flueric operational amplifiers and integrators. The amplifier gains and integrator rate gains are shown to depend only upon the passive circuitry. First- and second-order linear differential equations with constant coefficients have been solved effectively with these computing devices. Less than

2% deviation resulted between the computed and calculated first-order solutions. Computation of the second-order equations with damping greater than 0.8 also showed errors of 2 percent or less. With damping less than 0.8 but greater than 0.4, the error was less than 5%; with lighter damping including zero-damping, the error was a percent or less. Also included are suggestions for improving system accuracy and expanding the state-of-the-art for flueric computing systems. Author (TAB)

N66-35575# System Development Corp., Santa Monica, Calif.

GRAMMAR AND LEXICON FOR BASIC JOVIAL

Millard H. Perstein 10 May 1966 105 p refs
(TM-555/005/00; AD-635473) CFSTI: HC $4.00/MF $0.75

This is the reference manual for the basic JOVIAL version of the JOVIAL language. Basic JOVIAL is a subset of J3, which is the full language. This manual defines the full syntax and semantics of basic JOVIAL without drawing fine distinctions between the two aspects. Author (TAB)

N66-35552*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AUTOMATION OF POST-FLIGHT EVALUATION

Carlos Hagood *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 60-64 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

The feasibility of automating the evaluation of flight test data is considered. A large number of telemetry measurements can be scanned and useful information obtained in a minimum of computer and analyst time shortly after a launch. This information will provide early knowledge of minor deviations and malfunctions as well as some insight into the cause of failures, which allows a sound decision to be made as to what areas of the vehicle evaluation should be concentrated on and how computer time should be allotted. Based on results obtained by comparing the automated analysis with the detailed analysis of SA-5, approximately 85 percent of the deviations were detected. As additional experience is gained in using this approach, the scheme will be modified to improve its usefulness with respect to the tests performed. Data presentation can be improved also. Author

N66-35565# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.

HARDWARE DOCUMENTATION OF A GENERAL PURPOSE PAPER TAPE READER Technical Report No. 125

Charles Amann and Melvin Klerer Mar. 1966 21 p refs
(Contract Nonr-266(84))
(CU-150-66-ONR-266-PHYS; AD-635379) CFSTI: HC $1.00/MF $0.50

The electronic design and operating instructions for a general purpose paper tape reader are given. The reader will interface with a GE-235 computer and transmit any arbitrary 8-bit code. Author (TAB)

N66-35630# Massachusetts Inst. of Tech., Cambridge.

PROJECT MAC: PROGRESS REPORT II: JULY 1964 TO JULY 1965

1 Jul. 1965 211 p refs
(Contract Nonr-4102(01))
(MAC-PR-2; AD-629494) CFSTI: HC $6.00/MF $1.25

The broad goal of Project MAC is experimental investigation of new ways in which on-line use of computers can aid people in their individual work; whether research, engineering design, management, or education. Author (TAB)

N66-35654*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A FORTRAN IV TWO-DIMENSIONAL DISCRETE ANGULAR SEGMENTATION TRANSPORT PROGRAM

Clayton E. Barber Washington, NASA, Aug. 1966 190 p refs
(NASA-TN-D-3573) CFSTI: HC $3.25/MF $1.25 CSCL 18K

The development of the discrete angular segmentation method is given for solving the transport equation for a multigroup two-dimensional Fortran IV program. Finite-difference equations are derived in some detail and calculational procedures are discussed. The application of scaling and overrelaxation as methods to accelerate the convergence of the neutron fluxes is described. The effect of these methods on convergence rates for selected problems is shown. The program is described, including the input instructions, along with some notes concerning program operation. A sample problem and a Fortran IV listing are also included. Author

N66-35695# European Atomic Energy Community, Ispra (Italy). Metallurgy and Ceramics.

TABULATION OF FUNCTIONS [TABULATION DE FONCTIONS]

A. Hubaux and M. Lecloux Jun. 1966 30 p In FRENCH; ENGLISH summary
(EUR-2987-f) CFSTI: HC $2.00/MF $0.50

Description of a Fortran program for the IBM 7090 to easily obtain the tabulation of any function. The results are presented as a double-entry table and as a series of curves automatically drawn by the Calcomp data plotter. One needs only to write the Fortran instructions for the computation proper of the function, together with a few data to specify the values of the parameters. In the program, these data are checked, the table is computed and printed, and the curves are drawn. Anybody with only an elementary knowledge of Fortran IV language may use this program without bothering about input, output and dimensions problems. Author

N66-35712# Arizona State Univ., Tempe. Dept. of Industrial Engineering.

ANALYSIS OF STOCHASTIC NETWORKS

William Walton Mc Donald (M.S. Thesis) May 1966 113 p refs
(Contract AF 33(608)-1204)
(AD-635234) CFSTI: HC $3.00/MF $0.75

The purpose of this research was to: (1) develop a general purpose GERT simulation program, (2) investigate resultant distributions of GERT networks containing all AND nodes to determine validity of the PERT normality assumptions, and (3) investigate analysis of AND nodes through analytical and simulation methods for distribution of the equivalent time parameter. The simulation model is a fast, flexible, user-oriented computer program requiring only one input card for each activity in the network. Five probability density functions are available for use in describing the distribution of activity durations. Program output includes a criticality index on each activity and node analysis on specified nodes, including mean, variance, probability of realization and histograms of node realization times. Various GERT networks were simulated to provide examples of the use of the simulation model and verify results through statistical tests. Analysis of resultant distributions of PERT networks verified the PERT normality assumptions utilizing approximation formulas for mean and variance of activity durations. The merge bias correction procedure utilized to produce better approximations of network realization times was found not applicable to general solution of GERT networks containing AND nodes. Author (TAB)

N66-35738# Texas Univ., Austin. Linguistics Research Center.

LINGUISTIC INFORMATION PROCESSING STUDY Eleventh Quarterly Progress Report, 1 Nov. 1965–31 Jan. 1966

W. P. Lehmann and E. D. Pendergraft May 1966 121 p refs (Contract DA-36-039-AMC-02162(E))

(LRC-66-AMC-27; ECOM-02162-11; AD-635505) CFSTI: HC $4.00/MF $0.75

Generalized programming systems are now in operational use which (1) maintain large stores of linguistic corpora or descriptive data, (2) perform automatic syntactic analysis, synthesis or translation, (3) prepare concordances or linguistic statistics, (4) perform automatic classification, (5) perform coordinate and associative information retrieval, and (6) process informant data. The analysis and classification capabilities are being combined in a self-organizing linguistic system. Descriptive studies of several languages, notably English, German, Russian, Chinese, and Japanese, are in progress. Work is continuing in classification theory and algorithms, with applications in time-shared associative retrieval and automatic linguistic classification. Author

N66-35750# Joint Publications Research Service, Washington, D. C.

MACHINE SEARCH ALGORITHM FOR A DERIVATION IN PROPOSITIONAL CALCULUS

N. A. Shanin, G. V. Davydov, S. Yu. Maslov, G. Ye. Mints, V. P. Orevkov et al 25 Aug. 1966 58 p refs Transl. into ENGLISH of a Russian pamphlet

(JPRS-37224; TT-66-33653) CFSTI: $3.00

Details are given on the development of an algorithm for establishing the most natural logical derivation within the framework of the logical means of the classical calculus of expressions. The starting sequences of the calculus are characterized by symbolic expressions called the sequence schemes, and the rules of logical transitions are given. Data on the computer program are summarized briefly, and several examples of logical derivations established by the Ural-4 computer are presented. M.G.J.

N66-35777*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

INFORMATION PROCESSING AND DATA COMPRESSION FOR EXOBIOLOGY MISSIONS Status Report, Oct. 1965–Mar. 1966

Louis L. Sutro Jun. 1966 41 p refs Presented at the 12th Ann. Meeting of the Am. Astronautical Soc., Anaheim, Calif., 23–25 May 1966 Revised

(Contract NSR-05-020-010)

(NASA-CR-77564; R-545, Rev.) CFSTI: HC $2.00/MF $0.50 CSCL 09D

Techniques being developed for missions to Mars are part of a larger effort to develop a robot capable of carrying out programs and of self-programming within certain limits. Three development efforts at the Instrumentation Laboratory lead in this direction: Design of a layered processor like that in a frog's retina shows how a model of animal vision may reduce data for transmission to Earth and permit response to the environment. Design of a stereoscopic system suggests how a pair of layered processors, when fed data from two television cameras, may find the positions of objects. Design of a decision and control system like that of animals suggests how a system of this kind may decide in what direction a Mars lander should move, when it should perform each experiment and what it should report. Author

N66-35808# Oak Ridge National Lab., Tenn.

FOURIER ANALYSIS OF UNIFORM RANDOM NUMBER GENERATORS

R. R. Coveyou and R. D. Mac Pherson Nov. 1965 65 p refs (Contract W-7405-ENG-26)

(ORNL-3866) CFSTI: HC $3.00/MF $0.75

A method of analysis of uniform random number generators is developed, applicable to almost all practical methods of generation. The method is that of Fourier analysis of the output sequences of such generators. With this tool it is possible to understand and predict relevant statistical properties of such generators and compare and evaluate such methods. Many such analyses and comparisons were carried out. NSA

N66-35838# United Kingdom Atomic Energy Authority, Sellafield (England). Reactor Group.

A GENERAL-PURPOSE MULTIPLE REGRESSION PROGRAMME FOR THE IBM 7090

F. J. Chatterly 14 Feb. 1966 12 p

(TRG-1198(W)) HMSO: 1s 9d

The program accepts up to 25 variables and up to 2,000 values of each provided the total number of numbers read in is less than 10,000. Additional variables can be derived from those read directly. Means, standard deviations and correlations of the variables are all calculated. For each regression equation, the residual sum of squares and standard deviations and covariances of the coefficients are all available. Nonsignificant variables can be automatically eliminated. Details of the input data required and the output obtainable, together with mathematical definitions of all the quantities calculated, are included. Author (NSA)

N66-36019# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

QUESTIONS IN DESIGNING FOR THE HIGH-SPEED OPERATION OF UNITS AND THE EVALUATION OF THE PRODUCTIVITY OF DIGITAL COMPUTERS

Ye. I. Mamonov 18 Feb. 1966 18 p refs Transl. into ENGLISH from Vychislitel'naya Tekhn. (Moscow), no. 2, 1961 p 8-20

(FTD-MT-65-219; TT-66-61583; AD-634809) CFSTI: HC $1.00/MF $0.50

Translation of Russian research: questions in designing for the high-speed operation of units and the evaluation of the productivity of digital computers. TAB

N66-36026# Navy Electronics Lab., San Diego, Calif.

PROGRAMMING IN NELIAC MOD 7 WITH MOD 7 STAR OPERATING SYSTEM Self Instructional Manual

James A. Saxon and Marnette Moles Feb. 1966 278 p

(AD-635179) CFSTI: HC $6.00/MF $1.50

A self instructional manual is presented for the study of NELIAC computer programming language. It is reported that NELIAC was developed as a scientific language to enable computer solutions to mathematical problems and as a means of expressing these problems in an algebraic language rather than in detailed machine language. Problems are provided on each page with spaces provided for writing answers to the questions. The correct answers are given on the next page. The manual includes instruction on NELIAC grammar, dimensioning, program logic, arithmetic operations, control operation transfer, decision operations, iterative control operation, subroutines and functions, input/output statements, the magnetic tape and card handler, programming options, program implementation, and the MOD 7 Star operating system. A.G.O.

N66-36053*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF RANDOM PROCESS THEORY Final Report, 1 Jul. 1965–1 Apr. 1966
Charles J. Greaves Jun. 1966 119 p refs
(Contract NAS8-11346)
(NASA-CR-77875; XM-1970-B-2) CFSTI: HC $4.00/MF $1.00
CSCL 12A

This report is concerned with random process theory as applied to discrete-data processing. Both stationary and nonstationary data processing techniques are studied. Methods for reducing the computational times, associated with the digital generation of correlation functions for stationary processes, are described. A theory for developing optimal spectral smoothing weights is discussed, and the experimental results obtained from the application of this theory are included. The remainder of the report deals with the development of a practical discrete-data nonstationary correlation function detection theory. The experimental results achieved with the application of this correlation detector to Saturn launch vehicle vibration data are also presented. Author

N66-36059*# California Univ., La Jolla. Scripps Inst. of Oceanography.
COMPUTER PROGRAMS EMX AND EMX2 FOR ELECTRON MICROPROBE DATA PROCESSING
J. Z. Frazer, R. W. Fitzgerald, and A. M. Reid 20 Jun. 1966 77 p refs
(Grants NsG-317-63; AF-AFOSR-631-64)
(NASA-CR-77805; SIO-66-14) CFSTI: HC $3.00/MF $0.75
CSCL 09B

Computer programs EMX and EMX2, written in Fortran-63, that not only perform the necessary absorption and fluorescence corrections, but can also carry out almost the entire data handling operation during the processing of electron probe microanalysis data, are given. With these programs, the amount of data that would come from a normal 8 hrs of microprobe operation can be processed in a little more than one minute of CDC 3600 computer time, at a fraction of the cost that would be required for an individual to do the work using a desk calculator. The programs are versatile; they use the most appropriate correction procedures; and they eliminate all hand calculating and data sorting. The data processing and correction procedures are outlined. L.S.

N66-36132*# Midwest Research Inst., Kansas City, Mo.
USER'S MANUAL FOR A FORTRAN IV PROGRAM FOR COMPUTING FLUTTER BOUNDARIES OF FLAT PANEL ARRAYS IN SUPERSONIC FLOW
D. R. Kobett and D. I. Sommerville 8 Jul. 1966 105 p refs
(Contract NAS1-4900)
(NASA-CR-66121) CFSTI: HC $4.00/MF $0.75 CSCL 09B

This computer program is a by-product of panel flutter research efforts and was developed to facilitate the calculation of flutter characteristics for multi-bay, flat panel arrays exposed on one side to a uniform supersonic airstream. The program is written in Fortran IV for use on the IBM 7094 under IBSYS. The computation method used is straightforward in that a computer run directly obtains, as output, points on the boundary separating stable from unstable regions in a generalized flutter-parameter-plane. The method can be conveniently adapted to related applications, e.g., the flutter of a cylindrical shell or a wing-body configuration. The computer program is based on an analytical model which is briefly described. R.N.A.

N66-36316*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DATA-AUTOMATION SYSTEM
W. J. Schneider and D. L. Nay *In its* Mariner–Mars Sci. Subsystem 15 Aug. 1966 p 68–75 (See N66-36306 21-31)
CFSTI: HC $3.00/MF $0.75

The real-time and video data handling systems for the Mariner–Mars mission are summarized. The real-time data format, for the interplanetary cruise portion, consists of forty-two 10-bit words. The video system, for the planetary encounter portion, was designed to take 20 pictures, each containing 200 lines of 200 elements. The encounter sequence is also described. Diagrams are included for the real-time format, the encounter sequence logic, and the video system format. N.E.N

N66-36318*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENCE DATA PROCESSING
Stephen Z. Gunter and Michael J. Sander *In its* Mariner–Mars Sci. Subsystem 15 Aug. 1966 p 86–92 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The test data and flight operations support processing for Mariner IV are summarized. The data acquisition and processing during prelaunch and environmental test operations are described. Both TV and non-TV portions of the science subsystem are covered. Monitoring and analysis of flight performance was keyed primarily to computer processing. Details are given on (1) the real time processing, within 5 min of receipt, and (2) the near-real-time processing, within 24 hr of receipt. Diagrams are included for the spacecraft telemetry system, cruise data processing format, TV data system, flight data processing system, and science subsystem test data processing system. The formation of a master data library of all flight data was considered to be the most auspicious task undertaken, and the steps in producing the library are outlined. N.E.N.

N66-36418# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 340
29 Aug. 1966 17 p Transl. into ENGLISH from Tien Shih Chieh (Shanghai), no. 5-1966, May 1966 p 167–170
(JPRS-37272; TT-66-33701) CFSTI: $1.00

The trial manufacture of a 24-digit analog computer is described. The basic theories of the computer are discussed and its applications in various fields are pointed out. The multiplier amplifier, described as the basic component of the computer, has three capabilities as a comprising tool, integral amplifier, and differential amplifier. The computation amplifier, direct supply system, and construction and computation control are mentioned. A series of photo captions of workers at the Yang-Shu-P'u power plant is also included. L.E.W.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-35474# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR A GERMANIUM PNP POWER TRANSISTOR Quarterly Progress Report No. 4, 15 Jan.–14 Apr. 1966
Dan Sullivan and Paul Greer [1966] 43 p
(Contract DA-36-039-AMC-00161(E))
(W-19; AD-635480) CFSTI: HC $2.00/MF $0.50

Progress is reported of continuing process evaluation test, analyzing data on tests completed, reviewing the electrical parameter correlation problem on the third engineering sample, preparing Group B inspection data for the preproduction sample, modifying test circuits for power stress tests, preparing sockets required for the lot acceptance test of production devices, updating the SP1882H specification, preparing for the discriminant analysis test and large scale reliability test. Author (TAB)

N66-35475# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR SILICON OVERLAY TRANSISTORS Quarterly Progress Report, 1 Oct.–31 Dec. 1965
Michael Cassidy and Paul Greer [1965] 37 p
(Contract DA-36-039-AMC-00156(E))
(QPR-4; AD-635814) CFSTI: HC $2.00/MF $0.50

Progress during the past quarter has consisted of the following: (1) wafer preparation: processing of 1-1/2-inch slurry-polished and chemically etched wafers using the new preohmic two-step photoresist process, (2) mask resolution and alignment: vertical and horizontal dimensional inspection of masks to eliminate mask variations, (3) deionized water boil: evaluation of ultrasonically wire-bonded devices after subjection to deionized water boil, (4) wire bonding: evaluation of units fabricated using a Sono Bond ultrasonic bonder, (5) diffusion systems: final evaluation of the BCl_3 system; emitter diffusion employing a controlled $POCl_3$ source temperature, and (6) reliability evaluation: evaluation of completed units. Author (TAB)

N66-35580*# Microwave Electronics Corp., Palo Alto, Calif.
DEVELOPMENT OF A LOW NOISE, COLD-CATHODE TRAVELING WAVE TUBE Final Report, 28 Jun. 1964–31 Aug. 1965
G. Foggiato Sep. 1965 109 p refs With Rept. from Stanford Res. Inst.
(Contract NAS5-9002)
(NASA-CR-71842) CFSTI: HC $3.00/MF $0.75 CSCL 09A

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APPENDIX
6. COLD CATHODES FOR LOW-NOISE TWT APPLICATIONS D. V. Geppert and B. V. Dore (Stanford Res. Inst.) 47 p refs (See N66-35581 21-09)

N66-35581*# Stanford Research Inst., Menlo Park, Calif.
COLD CATHODES FOR LOW-NOISE TWT APPLICATIONS Final Report
D. V. Geppert and B. V. Dore *In its* Develop. of a Low-Noise, Cold-Cathode Traveling-Wave Tube Sep. 1965 47 p refs (See N66-35580 21-09)

The requirements for a practical substrate for the surface-barrier cathode are summarized, and a review of the various substrate designs is presented. The requirements for the semiconductor for the cathode are summarized, followed by a review of the efforts expended on the semiconductors ZnO and TiO_2. The more recent work on GaP is presented in greater detail. The requirements for the metal surface film are summarized, and a discussion is given of the status of metal/semiconductor contacts. The activation requirements are summarized, followed by a review of the measurements to date on evaporated BaO. The experimental results of the program are then reviewed. Emphasis is laid on the stability and long life that have been demonstrated for surface-barrier diodes under dynamic life test and for low-work function BaO/metal photosurfaces. Author

N66-35625# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR SILICON LINEAR INTEGRATED CIRCUITS
Quarterly Progress Report, 20 Jan.–20 Apr. 1966
Thomas Quaid, John Hatchett, and William Turner May 1966 28 p
(Contract DA-36-039-AMC-00158(E))
(QPR-4; AD-635498) CFSTI: HC $2.00/MF $0.50

The report describes the work accomplished to produce silicon linear integrated circuits of the type used in FM receivers. The effort was devoted to the fabrication and evaluation of engineering sample integrated circuits, preparation of specifications and test procedures for the five integrated circuits being developed, and the construction and evaluation of an engineering model receiver. Limiter/squelch and mixer/oscillator circuits were modified and new engineering samples were fabricated. Author (TAB)

N66-35643# Tung-Sol Electric, Inc., Bloomfield, N. J.
DEVELOPMENT OF A HIGH POWERED ELECTRON MULTIPLIER TUBE Summary Yearly Report, Jan. 15, 1964–Jan. 15, 1965 and Quarterly Report, Jan. 15–Apr. 15, 1965
R. Franklin [1965] 40 p
(Contract Nonr-4323(00)(X))
(QR-5; AD-624538) CFSTI: HC $2.00/MF $0.50

The U. S. N. 8455 multiplier was tested to find its duty cycle limit of operation. Two tubes were operated at two and one half per cent duty cycle for a combined total of 260 hours. Internal part processing modifications were made to eliminate gas evolvement during operation. These changes include: (1) The addition of vacuum firing of the nickel collector and the kovar outer shell. These parts are also hydrogen fired which is a continuation of the processing used with the U.S.N. 8455. (2) The dynodes are oxidized separately before mounting the tube. One U.S.N. 8455 was processed in this way and would not operate properly at dissipations higher than two and one half per cent. Tubes were constructed with modified internal elements. Tubes with modified construction were able to operate at higher duty cycle levels. An external copper radiator with concentric ceramic ring device were designed, parts procured, and the first tube is in final stages of assembly. This construction should help to evaluate tube performance under the 10% duty cycle conditions. Author (TAB)

N66-35724# California Univ., Berkeley. Lawrence Radiation Lab.
"DO-IT-YOURSELF" LOCK-IN AMPLIFIERS, RADIO AND AUDIO FREQUENCY

Kenneth W. Lamers 14 Jan. 1966 68 p refs
(Contract W-7405-ENG-48)
(UCRL-16632) CFSTI: HC $3.00/MF $0.75

Two specific lock-in amplifiers, one designed for radio frequency, the other for audio, are described. In view of the general utility of these amplifiers, included are detailed schematics, photographs, templates, and other data useful in duplicating either unit. NSA

N66-35733*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
ADVANCED DIGITAL CIRCUIT R AND D EVALUATION Final Report, 3 Oct. 1964–30 Sep. 1965
R. M. Stock [1965] 115 p refs
(Contract NAS8-11412)
(NASA-CR-68246; CAL-UD-2002-X-1) CFSTI: HC $4.00/MF $0.75 CSCL 09A

A program of evaluation and testing was carried out to determine the suitability of using integrated circuits in the Saturn IB and V Launch Vehicle Data Adapter. Three digital logic lines, a thick film hybrid DTL, a monolithic integrated DTL and a monolithic integrated TTL, were evaluated in each of three applications and comparative data prepared. Evaluation was carried out over the full temperature rating of each circuit and data taken on maximum frequency of operation, noise margin, power required, and power supply tolerance. A table was prepared to compare performance and included a comparison of circuit wiring complexity (number of connections) and circuit size (number of modules). Author

N66-35788*# Materials Research Corp., Orangeburg, N. Y.
FABRICATION AND DELIVERY OF NON-DESTRUCTIVE READ OUT MEMORY BUFFERS USING LAMINATED LAYER TECHNIQUE Summary Technical Report
Neal Kenny, Theodore P. Janus, and Raymond J. Carpenter Jun. 1966 110 p
(Contract NAS8-11986)
(NASA-CR-77488; MRC-549) CFSTI: HC $4.00/MF $0.75 CSCL 09A

Summarized are results of research designed to determine if laminated foil techniques can be used to fabricate nondestructive read out memory buffers. Included are results of material and processing studies, a device design study in which a number of different magnetic storage devices composed of magnetic foils were examined and tested, and a study having as its objective the design and assembly of a memory incorporating the foil storage device. It is concluded that metallic foils with very uniform composition, structure, and performance could be produced and successfully used in electronic memories. A new geometry for foil storage devices was developed, assembled, and successfully operated. A card programmable memory, the operation of which is based on the same foil devices, was also designed, assembled, and delivered. In the card-programmable memory, the foil devices are used to read, at high speed, the information stored on magnetic cards. By using a novel design principle, the foil devices are capable of reading the information from the cards at high speed without any relative motion between the foil devices and cards. S.C.W.

N66-35773*# Research Triangle Inst., Durham, N. C.
SOME EFFECTS OF MECHANICAL STRESS ON THE BREAKDOWN VOLTAGE OF p-n JUNCTIONS
J. R. Hauser and J. J. Wortman [1966] 38 p refs Submitted for Publication
(Contract NASr-222)
(NASA-CR-77627) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Various factors determining stress induced changes in the breakdown voltage of Ge and Si p-n junctions are discussed. A model is developed which accounts for the multivalley band structure of semiconductors such as Ge and Si. Analytic expressions are developed for the change in breakdown voltage, $\Delta V/V_b$ as a function of a general stress. For Si, a linear decrease in $\Delta V/V_b$ with increasing stress is predicted. The proportionality factor is of the same order of magnitude as the band gap dependence on hydrostatic pressure. For Ge, an initial increase in $\Delta V/V_b$ followed by a decrease at high stress levels is indicated. The model is shown to be consistent with reported experimental data. Author

N66-35902# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
RELIABILITY OF PLANAR SILICON TRANSISTORS EXPOSED TO Co γ RAYS [FIABILITE DE TRANSISTORS AU SILICIUM, A STRUCTURE PLANE, SOUMIS AU RAYONNEMENT γ DU ^{60}Co]
André Blin and Jacques Le Ber Mar. 1966 76 p refs In FRENCH
(CEA-R-2959)

Results are presented from investigations on the reliability of silicon planar transistors, irradiated by the Co^{60} γ rays. The variation of the average values of the parameters of the lots under test is considered. Then, a more complete statistical study is carried out (distribution of the values of the parameters within the lots; research of correlations, etc.). It is clearly stated and shown that evaluation of the degradation of the gain of transistors depends on: the conditions of measurement (voltage, current), after irradiation, the polarization of the elements during irradiation, and the origin of manufacture of the lots under test (4 manufacturers). Difficulties met to predict the behavior of the transistors under radiation stress were discussed, and an attempt was made to define practical rules for design engineers.
Author (NSA)

N66-35975*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
DEVELOPMENT OF THREE TYPES OF FLAT FLEXIBLE CONDUCTORS Final Report, Aug. 1963–Feb. 1964
C. F. Seck 24 Feb. 1965 43 p
(Contract NAS8-5424)
(NASA-CR-77775; TP-594) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Development and production of two types of cable are described. Commercially available materials, manufacturing equipment, material compatibility, fabrication problems, cable weight, stiffness, dielectric strength, wire spacing tolerances, and other specified requirements were evaluated. Silicon rubber reinforced and unreinforced, TFE Teflon reinforced, filled and unfilled; and H-film Teflon bonded cables were examined. The only cable which met the requirements was made of TFE Teflon white pigment filled. A combination of insulation materials, shielding designs, and methods of connecting the shield to the ground conductor were tested. A Mylar "A" insulation bonded cable with polyester adhesive loaded with dechlorane and antimony trioxide was submitted for preliminary evaluation but was not accepted because of brittleness and stiffness. Author

N66-35979*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
IMPROVEMENTS IN ELECTRONIC COMPONENT TESTING
M. J. Berkebile *In its* Res. Achievements Rev. Ser. No. 10 1965 p 21–29 (See N66-35976 21-15) CFSTI: HC $2.00/MF $0.50 CSCL 09C

A nondestructive radioisotope tracer method for finding seal defects in acceptance testing is described. Development and problems in quality control of integrated circuits includes a discussion of semiconductors, thin-film techniques, and packaging. Investigations were made of the reliability of soldered and welded electrical connections. Solderability ratings

were established for component lead-connection materials, with similar ratings for welded connections. An infrared radiation method for electrical functioning tests and failure detection is described. Charts and graphs containing experimental results are included. K.W.

N66-35985*# ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH IN THE DEVELOPMENT EFFORT OF AN IMPROVED MULTIPLIER PHOTOTUBE Seventh Quarterly Report
F. H. Barr and E. H. Eberhardt 24 Jun. 1966 37 p refs
(Contract NASw-1038)
(NASA-CR-77766; ITTIL-66-1037) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Test data are presented on a tube having an 0.5 inch effective diameter cathode and a 12-stage multiplier. To determine the effective photocathode size and the response uniformity, the photocathode was mechanically scanned with a small spot of light while the multiplier output was monitored with a dc oscilloscope. The data are plotted as a function of displacement along two mutually orthogonal diameters. It is shown that the effective cathode dimensions are about 0.6 by 0.5 inch when measured at the half amplitude points. Plots are also included to show the multiplier response time and the pulse amplitude distribution characteristics. Methods of improving the quantum efficiency of multiplier phototubes are considered, with emphasis focussed on more efficient use of the incoming radiation at the photocathode. An arrangement is described in which a prism is affixed to the faceplate of the tube. The incoming flux is injected into the faceplate at the critical angle so that it is trapped between the two surfaces, and multiple reflections occur causing photoelectrons to be emitted each time the light passes into the cathode layer.
M.G.J.

N66-35997# Commissariat a l'Energie Atomique, Saclay (France). Departement des Radioelements.
MEASUREMENT OF DIRECT CURRENTS OF UNDER 10 $^{-10}$ AMPERE AND OF RESISTANCES OF $10^{12}\omega$ FOR A DIRECT CURRENT [MESUR DE COURANTS CONTINUS INFERIEURS A 10 $^{-10}$ AMPERE ET DE RESISTANCES DE $10^{12}\omega$ POUR COURANT CONTINU]
Jacques Vagner Nov. 1965 69 p refs In FRENCH
(CEA-R-2834; PB-169165)

The ionization chamber and current generator used to measure direct current and resistance are described. Reported are measurements of currents lower than 10 $^{-10}$ amperes in combination with resistances of 10^{12} omega for direct current. The method makes use of the ionization chamber of a current generator, and measurements of the difference in electric potential at the voltage terminals. Experiments with alternating current generators are also recorded; results obtained are compared with direct current measurements and found to be satisfactory. Transl. by R.LI.

N66-36034# Philco Corp., Fort Washington, Pa. Techrep Div.
HANDBOOK OF MINIATURE PARTS AND INTEGRATED CIRCUIT DEVICES FOR ELECTRONIC EQUIPMENT
Washington, Bur. of Ships, 15 May 1965 285 p Supersedes Navships-93440(B)
(Contract N600(24)-62008)
(NAVSHIPS-0967-031-1000; NAVSHIPS-93440(B); AD-635817) GPO: HC $2.25; CFSTI: MF $1.50

The handbook is divided into two parts. Part I contains the description and illustration of miniature electronic components, such as capacitors, resistors, etc; Part II contains the description and illustration of functional units (circuits), such as amplifiers, oscillators, etc. An explanation of the presentation of material within each part is given at the beginning of each part. TAB

N66-36039# Illinois Univ., Urbana.
BIPOLAR NEGATIVE RESISTANCE FROM METAL-OXIDE-METAL STRUCTURES
Charles Wesley Mitchell (M.S. Thesis) 1966 40 p refs
(AD-635244) CFSTI: HC $4.00/MF $0.50

Results of an effort to fabricate a practical metal-oxide-metal negative resistance device (termed an assistor) are reported. No such device was forthcoming, and it is concluded that thin-film techniques seem to be the ultimate answer to the problem. TAB

N66-36057*# Texas Instruments, Inc., Dallas.
STUDY OF SOLID-STATE INTEGRATED MICROWAVE CIRCUITS Scientific Report No. 2, 15 Dec. 1965-14 Mar. 1966
31 Mar. 1966 75 p refs
(Contract NAS12-75)
(NASA-CR-77802) CFSTI: HC $3.00/MF $0.75 CSCL 09A

A study of basic frequency-modulation telemetry transmitter configurations suitable for use in the 1- to 2-GHz frequency range is presented. The purpose of this study is to establish the framework within which a detailed analysis of the system requirements in terms of components, techniques, and devices can be made with the objective of demonstrating the system performance when implemented in integrated circuitry. The study includes the objective specifications, bandwidth determination, AFC control system parameters, and a discussion of eleven basic configurations. Author

N66-36115*# Hughes Aircraft Co., Fullerton, Calif.
TRANSISTOR DESIGN EFFECTS ON RADIATION RESISTANCE
V. R. Honnold, G. D. Thomas, and C. C. Berggren Washington, NASA, Sep. 1966 73 p refs
(Contract NAS1-4595)
(NASA-CR-590) CFSTI: HC $2.50/MF $0.75 CSCL 09A

The problem of minimizing the degrading effect of high energy space radiation on a double diffused silicon planar transistor, and the radiation response of a majority carrier device (a multichannel field effect transistor intended for high frequency, high power application) were investigated. The following design variations were found to be significant for radiation resistance: small emitter area, heavy emitter doping, small base width, gold doped collector, and Czochralski material; it was demonstrated that these desirable variations could be incorporated into a radiation resistant prototype silicon planar transistor. The prototype transistor in tests with 31 MeV protons, and in comparison with three devices of other manufacture, showed the smallest degradation rate. Analytical expressions correlating the experimental results and furnishing the basis for further design studies are also reported. R.LI.

N66-36158# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
ION CHAMBER dc AMPLIFIER
D. J. Cambell Jun. 1966 24 p refs
(AECL-2536; ELI-70) CFSTI: HC $1.00/MF $0.50

This unit was primarily designed as a reaction neutron flux safety amplifier and as such, requires an ionization chamber as a sensing element. The amplifier may be used to measure low currents from a high impedance source over the range 10^{-12} to 10^{-4}A full-scale. The circuit consists of an electrometer tube input stage followed by a semiconductor dc amplifier and alarm circuit. Input current level is determined by the

voltage across a feedback resistance which is selected either remotely or internally, through the use of dry-reed switches. The voltage is presented on a 0–10 V meter and is available for recorder indication. This report contains a circuit description and describes the functions of the various controls. The performance of a prototype model is also included. Author

N66-36222# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
LABORATORY TESTING AND THEORETICAL STUDIES IN TRANSIENT RADIATION EFFECTS ON MICROELECTRONICS Research Report, 1 Sep. 1964–31 Jul. 1965
W. W. Grannemann, Harold D. Southward, William J. Byatt, Lewellyn Boatwright, Harold Cates et al Kirtland AFB, N. Mex., AF Weapons Lab., May 1966 150 p refs
(Contract AF 29(601)-6637)
(AFWL-TR-65-175; AD-634493) CFSTI: HC $4.00/MF $1.00

A series of experimental studies was conducted on transistor elements suitable for microcircuits. A relationship of transient radiation effects to active volume and other parameters was made. The experimental and theoretical method developed offers a way of obtaining minority carrier lifetimes, depletion layer width, junction area, diffusion length, and active volume when the absorbed dose and the ionization efficiency are known in the transistor element of a microcircuit. Conversely, given the above parameters it is possible to determine the primary photocurrent of the microcircuit junction under a variety of radiation conditions. It was shown that the fundamental Boltzmann equation describing charge transport in semiconductors can be used to modify the usual continuity equation to obtain a more accurate circuit model for transistor elements in microcircuits. The oxide-isolated microcircuits were tested and compared with the usual backbiased isolation junction diode type. TAB

N66-36223# Army Electronics Labs., Fort Monmouth, N. J.
AN ADVANCEMENT IN TRANSISTOR SECOND BREAKDOWN PERFORMANCE USING MOLYBDENUM METALIZATION
Edward B. Hakim May 1966 16 p refs
(ECOM-2716; AD-634763) CFSTI: HC $1.00/MF $0.50

Transistors which have become inoperative due to collector-emitter short circuits have usually been driven into second breakdown. Second breakdown itself, however, is not the destructive mechanism. Alloying of the contact metalization into the device produces the short circuit which is observed. This report describes the experimental results of transistors having molybdenum–aluminum metalization compared to devices with only aluminum contacts. The results indicated that devices with molybdenum, when driven into second breakdown, would outlive aluminum units with respect to current by a factor of three. Author (TAB)

N66-36228# Army Electronics Labs., Fort Monmouth, N. J.
STUDIES OF VACUUM BREAKDOWN BETWEEN MICRON-SIZED AREAS
Hans Hieslmair Apr. 1966 19 p refs
(ECOM-2699; AD-634761) CFSTI: HC $1.00/MF $0.50

Vacuum breakdown between broad-area electrodes is initiated and occurs in localized areas of the electrodes. A new method of investigating such localized areas with a modified 'Muller' microscope is described and results are discussed. The method consists of scanning a metal surface with a small-area electrode (anode) at constant current and constant voltage. In this manner a plot of the cathode surface is obtained and micron-sized inhomogeneities can be detected. The experimental results indicate that changes of the electrodes occur even at current levels of 10^{-10} amperes when the surface is scanned for the first time. Apparent inhomogeneities of the cathode surface can be created or destroyed by current pulses of microamperes. Using the Fowler–Nordheim equation for the analysis of the emission data, it was found that the field enhancement factor is a function of gap spacing, that the field enhancement factor can change slightly at current levels of 10^{-10} amperes and can change drastically at current pulses of a few microamperes. The latter current pulses are usually accompanied by pressure increases. Author (TAB)

N66-36230# Bendix Corp., Holmdel, N. J. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE FOR IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY OF SILICON TRANSISTOR TYPE 2N3055 First Quarterly Progress Report, 1 Jan.–31 Mar. 1966
John Mechura and Robert Bolvin [1966] 145 p
(Contract DA-36-039-AMC-06171(E))
(Rept.-1; AD-633012) CFSTI: HC $4.00/MF $1.00

The purpose of the work performed in this contract is: to establish process improvements for the silicon transistor type 2N3055 so as to attain improved operating reliability level per 1000 hours at 25°C with 90% confidence level, to incorporate two process improvements into the production facilities, and to supply engineering test samples incorporating the improved processes. During the first quarter, one group of engineering test samples were shipped as per the contract requirement. The major areas of engineering activity during the report period were on the following device processing steps: geometry studies, mechanization studies, diffusion studies, wafer requirement studies, contact metallization studies, assembly studies, and device rating studies. A program management chart was developed, submitted and accepted for the work planned during this contract period of eighteen months. TAB

N66-36231# TRW Semiconductors, Inc., Lawndale, Calif. Research and Development Dept.
TRANSISTOR, VHF, SILICON, POWER TYPE EL-2N (X-9) 5W 500 Mc PEM Quarterly Report, 1 Nov. 1965–31 Jan. 1966
R. Clarke, J. Crishal, J. Rice, P. Risinger, and W. Weisenberger [1966] 72 p
(Contract DA-36-039-AMC-06163(E))
(QR-3; AD-633147) CFSTI: HC $3.00/MF $0.75

Processing of lots continues to reduce the base width to 0.3 to 0.45 micron on a controllable basis. Sputtered metallizing has been accomplished. The glassified molded package has been modified to facilitate its use in the circuit and to simplify assembly. Interim interdigitated (four) and interrupted emitter (six) patterns were produced and evaluated for optimum performance. Only the interdigitated pattern with the largest dimensions (0.3 mil metal strips with 0.2 mil clearance) was noticeably poorer than the rest. The remaining nine patterns typically produced 10 watts at 500 mc and 28 volts, with 6.0 to 7.5 dB of power gain and 60 to 70% collector efficiency. These results were used to produce a final interdigitated pattern, which has initially produced 10 watts with 7.0 to 7.5 dB of power gain with 65 to 70% collector efficiency. Author (TAB)

N66-36235# General Electric Co., Lynchburg, Va. Communication Products Dept.
MICROMINIATURE CRYSTAL UNIT TYPE CR-(XM-47)/U PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 27 Nov. 1965–27 Feb. 1966

R. L. Hatcher and R. D. Laney [1966] 30 p
(Contract DA-36-039-AMC-06166(E))
(QPR-3; AD-633322) CFSTI: HC $2.00/MF $0.50

Engineering sample group No. 3 was completed and shipped to the customer on schedule. The aging problem has been isolated and corrective action taken. An additional engineering sample group is being submitted for evaluation. In process quality control equipment is complete. The reliability equipment is being assembled. Manufacturing personnel have been trained. Author (TAB)

N66-36274# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

CHARGED PARTICLE COUNTING SYSTEM, WITH PARTICLE SEPARATION BY dE/dx MEASUREMENT

A. Bahnsen and R. W. West 1 Jan. 1966 18 p refs
(Contract AT(30-1)-875)
(UR-875-117) CFSTI: HC $1.00/MF $0.50

A counter and electronic system designed for the purpose of identifying charged particles is described. It consists of a proportional dE/dx counter-solid state E counter telescope, a pulse multiplier and additional electronics to store the energy spectra of protons and deuterons in separate parts of a 400-channel analyzer. This system was used in an investigation of the $^{12}C(d,p)$ reaction near 4 MeV. The discussion is concerned with the problem of identifying protons and deuterons. But with minor changes, the system is applicable to other particles. The design and performance of the particle detector and the electronics system are considered, and the data reduction is also discussed. NSA

N66-36285*# Israel Program for Scientific Translations, Ltd., Jerusalem.

TRANSFLUXORS AND THEIR APPLICATION IN AUTOMATION AND REMOTE CONTROL

L. D. Kravchenko 1966 58 p refs Transl. into ENGLISH of the Publ. "Transflyuksory V Ustroistvakh Teleupravleniya" Kiev, Izd. Tekhn., 1964, 2d ed. Published for NASA and NSF
(NASA-TT-F-347; TT-66-51032) CFSTI: HC $3.00/MF $0.75 CSCL 09A

A description is given of design methods and practical circuits using transfluxors. These transfluxors are magnetic cores of complex configuration having several paths for the magnetic flux, and which replace several simple elements. Design considerations include principles of operation, main relationships used in transfluxor calculations, determinations of the geometrical dimensions of two-apertured transfluxors, and preparation and grading. The descriptions of characteristics and circuits incorporate methods for placing the windings in the circuits, ac energizing, and a brief theory of transistor circuits. Applications include computer technology, current-steering systems, automation, remote control devices, and multi-apertured uses. C.T.C.

N66-36353# Eidgenossische Technische Hochschule, Zurich (Switzerland).

THEORETICAL AND EXPERIMENTAL FOUNDATIONS OF AN ELECTRON TUBULAR MULTIPLIER [FONDEMENTS THEORIQUES ET EXPERIMENTAUX D'UN MULTIPLICATEUR D'ELECTRONS A TUBES]

Jacques Linder (Ph.D. Thesis) 1965 77 p refs In FRENCH; ENGLISH summary
(Rept.-3648) CFSTI: HC $3.00/MF $0.75

This paper describes and discusses the working principle of an electron multiplier consisting of a cylindrical tube; its inner walls are slightly conducting and display a good secondary emission coefficient. The theoretical part of this paper gives the equations governing the multiplication factor of the tube. Numerical calculations describe the actual results obtainable. Practical experiments have been carried out which have proved the working qualities of the tubular multiplier. Lastly, some suggestions are made relating to the applications of such multipliers in image amplifiers. Author

N66-36364# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.

PHASE LOCKED FREQUENCY MULTIPLIER FOR A SPEED- AND PHASE SYNCHRONIZATION SYSTEM BETWEEN A D.C.- AND A SYNCHRONOUS MOTOR

F. May Jul. 1966 20 p refs
(EUR-2999.e) CFSTI: HC $1.00/MF $0.50

A phase locked frequency multiplier is described, which is designed for the purpose of a speed synchronization and phase control system a d.c.- and a synchronous motor. The speed of the motors is normally set to 6000 rpm. Two reference pulses per revolution delivered by the pick-up system of the dc motor are multiplied by a factor of six. The multiplier is realized by means of a multivibrator which is controlled by a phase detector. In connection with the frequency multiplier a phase control system for the synchronous motor is pointed out. Any phase relation between d.c.- and synchronous motor could be achieved by adjusting the mechanical angle of the pick-up system mounted on the synchronous motor. The phase control system has not been realized. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-35649*# Honeywell, Inc., St. Paul, Minn.

DATA REQUIREMENTS FOR IN-FLIGHT SYNTHESIS AND MULTIPLE BLENDER STUDIES

L. D. Edinger and G. D. White Washington, NASA, Aug. 1966 227 p refs
(Contract NAS8-11206)
(NASA-CR-548) CFSTI: HC $6.00/MF $1.25 CSCL 17G

An analysis was performed in the following studies: (1) data requirements for in-flight synthesis; and (2) multiple blender study. The objective was to develop improved techniques for the control of large flexible boosters of the Saturn class. The flight control problem was broken into two parts: (1) identification and (2) synthesis. The data requirements for in-flight synthesis study concentrated on the synthesis problem, and design requirements for an identification process were established. The multiple blender study sought to extend the basic rate gyro blender concept for control of two independent structural bending modes. This was accomplished by blending three rate sensors using three adaptive blenders. As a result of the in-flight synthesis study, a control system was successfully defined which met damping augmentation requirements on the first two bending modes. Data regulation by an identification process and the accuracy of the regulation were also defined. The concept of multiple blending was found to be feasible; however, an improved blender logic was suggested. Author

N66-36022# Oklahoma State Univ., Stillwater.
SEQUENTIAL SOLUTIONS IN NONLINEAR CONTROL THEORY
Buck F. Brown Jul. 1964 95 p refs
(Publ.-143) Available from Okla. State Univ., Stillwater: $3.50

The results are presented of a study based upon a method of linearizing certain nonlinear mathematical models of control systems. The linear model is described, and operational methods and the sequential solution are discussed. It is pointed out that the solution obtained by this method is only approximate but the difference between this approximation and the actual solution is maintained within a specified tolerance. A block diagram representation of the nonlinear system is developed, and the root ensemble constructed from this representation is examined. Consideration is also given to the operation of nonlinear systems as plants in closed loop control. The root locus technique is used to point the way toward obtaining the desired response characteristics from these nonlinear devices. The determination of mathematical models of typical nonlinear systems, and a Fortran listing of the program used to compute autonomous response of the nonlinear oscillator are also included. A.G.O.

N66-36105# Joint Publications Research Service, Washington, D. C.
THE SYNTHESIS AND APPLICATION OF PERCEPTRONS
K. N. Denisov and Ye. N. Perevezentsev 2 Sep. 1966 24 p refs Transl. into ENGLISH from Tr. Avtomatiz. i Vychislitel'naya Tekhn. Na Morskom Flote (Moscow), No. 77, 1965 p 74–88
(JPRS-37407; TT-66-33835) CFSTI: $1.00

Two investigations dealing with the synthesis and application of perceptrons are presented. The first deals with a study of the functional properties of a trainable automaton of the perceptron type having two and three valued thresholds and associative elements with distributed parameters for recognizing the flat black and white images of a printed text. The second study is concerned with the problem of synthesizing the logical network for a digital perceptron. The solution involves using the methods of optimal encoding and linear programming theory. R.N.A.

N66-36153# Joint Publications Research Service, Washington, D. C.
A VARIABLE-STRUCTURE AUTOMATIC CONTROL SYSTEM WITH LOW SENSITIVITY TO RAPID, BROAD CHANGES IN THE PARAMETERS OF THE OBJECT OF CONTROL
S. V. Yemel'yanov, M. A. Bermant and V. I. Utkin 2 Sep. 1966 19 p refs Transl. into ENGLISH from Samonastraivayushchiyesya Sistemy (Moscow), 1965 p 126–136
(JPRS-37404; TT-66-33832) CFSTI: $1.00

The synthesis of automatic control systems for linear objects of second and third order with varying coefficients for the required dynamic properties, is discussed. It is assumed that (1) in the space of the states of the system there is some subspace in which the motion does not depend on the parameters of the object, and (2) for any initial conditions the solution of the system falls in this subspace and does not leave it. Then, if the motion in this subspace is stable and satisfies the required quality indices in the control process, the system will have a low sensitivity to parameter changes of the object. G.G.

N66-36156# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
DETERMINATION OF STATISTICAL PARAMETERS OF THE TRIPLE COINCIDENCE CIRCUIT ON THE BASIS OF A SINGLE EMPIRICAL DELAYED COINCIDENCE CURVE
Jozef Kalisz Apr. 1966 28 p refs
(INR-704/III/PL) CFSTI: HC $2.00/MF $0.50

Two mathematical methods for determination of the main coincidence-circuit parameters /resolving time, jitter breadth, efficiency/ on the basis of a single empirical delayed-coincidence curve are described. The general approach based on the assumption of Gaussian jitter distributions is presented and some particular cases are considered. Author

N66-36157# Polish Academy of Sciences, Warsaw.
DETERMINATION OF COINCIDENCE-CIRCUIT STATISTICAL PARAMETERS BY MEANS OF THE POINT METHOD
Jozef Kalisz Apr. 1966 16 p refs
(INR-703/III/PL) CFSTI: HC $1.00/MF $0.50

A mathematical method allowing determination of the resolving time, jitter breadth and efficiency of the two-fold coincidence circuit is described. The method may be used at the assumption of Gaussian jitter distributions and is an alternative to the earlier published "G-parameter method". Exact graphs and an example illustrating the method are given. Author

N66-36171# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
SECURITY DISCHARGE FOR HIGH TENSION SOURCE [DISPARO DE SEGURIDAD PARA FUENTE DE ALTA TENSION]
A. Battista and H. Picard 1966 14 p ref In SPANISH
(CNEA-176) CFSTI: HC $1.00/MF $0.50

A transistorized circuit safety device was developed to control high tension source supplying power to reactors. The purpose of the circuit is to prevent possible power failures of the high tension source originating from various causes (poor functioning, feed failure, etc.) which could in turn produce a malfunction in the reactor control system. The circuit is operated by the regulating current of the high tension source, and the alarm signal through relays; these close when there is a voltage feed or functioning error. The operating temperature range is from 0°C to 55°C. Described is the principle of operating which includes the high tension detector and the safety device. An electron circuit diagram is shown, and the system of thermal stabilization is given. Transl. by R.LI.

N66-36260*# Arizona Univ., Tucson. Engineering Research Labs.
CONTROL SYSTEM DESIGN BY STATE VARIABLE FEEDBACK TECHNIQUES Annual Status Report, Volume I
Donald G. Schultz Jul. 1966 102 p
(Grant NsG-490)
(NASA-CR-77901) CFSTI: HC $4.00/MF $0.75 CSCL 09C

A method of linear system synthesis is outlined that utilizes state variable feedback from real existing physical quantities to obtain the design criteria of a closed loop response control system. Alternate means of representing state variable feedback systems are explored and the H equivalent method is applied to the simplest case. Possible modifications and design procedures are discussed and a number of less definitive approaches are considered. G.G.

N66-36390*# Virginia Univ., Charlottesville. Div. of Mechanical Engineering.
ANALYSIS AND IMPROVEMENT OF ITERATIVE METHODS FOR SOLVING AUTOMATIC CONTROL EQUATIONS Semiannual Status Report, Feb.–Aug. 1966
James W. Moore Sep. 1966 20 p refs
(Grant NsG-635)
(NASA-CR-77940; ME-4023-103-66U) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Intensive studies were made of Gustafson's approximation techniques and of Krishnamurthy's matrix iteration techniques for finding roots. Emphasis is placed on shortening Krishnamurthy's process by introducing various modifications. In this method of root finding, a companion matrix is formed of a given polynomial, and the eigenvalues of the matrix are found. Since the eigenvalues of the companion matrix are equal to the roots of the polynomial, the root finding problem is converted to an algebraic eigenvalue problem. A summary is given of Gustafson's approach to approximating control equations, in which two second order transfer functions are produced whose time response approximates the time response of an nth order system. C.T.C.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-35479# Joint Publications Research Service, Washington, D. C.

TEMPORARY PULSE TYPE SUPERSONIC WIND TUNNEL

Chung Yen *In its* Transl. on Communist China: Sci. and Technol. 15 Aug. 1966 p 9-12 Transl. into ENGLISH from Hang-K'ung Chih-Shih, no. 10, Sep. 1965 p 4 (See N66-35477 21-34) CFSTI: $1.00

The main component parts of a temporary pulse type supersonic wind tunnel are described. Brief discussions are included of the air chamber, the pressure adjustment valve and flow stabilizing section, the lavar jet section, the test section, and the exhaust section and sound elimination tower. H.S.W

N66-35514*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

A PRELIMINARY LOGISTICS BURDEN MODEL FOR THE PRODUCTION OF LUNAR ORES

Carl B. Hayward 15 Aug. 1964 *In* Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 289-311 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

This report of a preliminary study attempts to establish a logistic burden model for lunar mining and ore dressing to support the production of water, oxygen, and other logistically important life-support and propellant substances from lunar rock. Mining methods and equipment are sensitive to many factors, and perhaps the most important of these is the required production rate. This study, therefore, is based on system production ratings of ten and one hundred times a modular unit (M) equivalent to 9 lb/hr of water or 8 lb/hr of oxygen. The mining concept upon which the study is based involves the use of chemical explosives and one or more special mining machines which, with one exception, are all vehicular in nature. Initial mining efforts are presumed to be surface operation. Conclusions include the logistic burden rates for capital equipment, consumable supplies, electric power, and manpower—all expressed as a function of the production order of magnitude. Author

N66-35516*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ECONOMIC ANALYSIS OF EXTRATERRESTRIAL PROPELLANT MANUFACTURE IN SUPPORT OF LUNAR EXPLORATION

David Paul, III 15 Nov. 1965 *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 341-376 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

Economic considerations, affecting a transport or manufacture decision concerning the resupply of propellants for use in lunar exploration operations, are developed and analyzed. Factors are suggested which will be prerequisites to an economic justification for the manufacture of propellants from lunar resources. This paper presents a postulated extrapolation of a lunar surface activities framework, establishes therefrom a demand estimate, considers a number of lunar resource processing concepts, and establishes the economic break-even conditions between transport and manufacture modes of resupply. Parametric results are presented which will permit basic decisions to be formulated concerning the desirability, from an economic view-point, of planning for lunar propellant manufacture as an adjunct to advanced lunar operations. In particular, the analysis concentrates on the use of propellant manufacture to support crew rotation flights from the lunar station to Earth (preliminary analyses have designated this as a most promising area for concentration). This paper will support a first order answer to the question of economic feasibility related to lunar propellant manufacture within the lunar exploration era of lunar activities. Author

N66-35517*# General Dynamics/Fort Worth, Tex.

SPACE TRANSPORTATION LOGISTIC REQUIREMENTS COMPARISON UTILIZING LUNAR MANUFACTURED PROPELLANTS

R. A. Gorrell and J. B. Deodati *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 377-398 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

The economic feasibility of utilizing lunar produced propellants is considered for Earth orbital, Lunar base, and Mars-lander missions. Various refueling modes in Earth orbit, lunar orbit, and lunar surface are investigated and propellant demand rates for each mission/refueling mode combination are determined. Lunar production and storage facilities requirements are investigated and base personnel and logistics support requirements are assessed. Saturn V launch vehicles and logistic payload time-sequences for mission support are developed. A comparison is made of the effectiveness of performing the various missions with and without the use of lunar produced propellants in terms of total Earth launch requirements. The improvement in effectiveness as a function of time and the number of missions performed is assessed. Sensitivity effects are evaluated and conclusions are drawn regarding the more promising concepts for utilizing lunar propellants. Author

N66-35518*# Boeing Co., Seattle, Wash.

THE ROLE OF LUNAR RESOURCES IN POST-APOLLO MISSIONS

Howard Segal *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 399-416 (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

An economic analysis of extra-terrestrial oxygen or fuel production, both with and without lunar resources is presented. The question of whether it is cheaper to manufacture a specific fuel on the Moon or on the Earth and transport it to the Moon is discussed. The break-even point between manufacture and transport is obtained by plotting the respective curves and

determining their slope and displacement differences. The slope and displacement of these curves are dependent on mission resource demands, processing costs, and fixed costs. Mission resource demands are listed as life support, mobility, earth return propulsion, and planetary mission fuel demands. Lunar fuel demands for crew rotation, production costs, and crew rotation costs are discussed and accompanied by diagrams. The crew rotation systems considered are only those using committed hardware or those requiring small technology improvements. S.P.

N66-35551*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

VARIABLE POROSITY WALLS FOR TRANSONIC WIND TUNNELS

A. Richard Felix *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 54–58 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

Variable porosity walls were recently installed in the transonic test section of the 14 by 14-in. trisonic tunnel. Evaluation tests indicated that use of these walls greatly improves the ability to produce reasonably accurate model pressure distribution data throughout the critical and difficult Mach range from 1.0 to 1.25. The evaluation was accomplished by comparing pressure distributions for a 20° cone–cylinder model with interference-free data for the same model. The range of porosities used is between 0.5 and 5.4 percent with the holes being slanted 60°. Author

N66-35629# Coating and Chemical Lab., Aberdeen Proving Ground, Md.

PRELIMINARY INVESTIGATION OF THE TEMPERATURE-FLOW-CORROSION UNIT AS A TOOL FOR COOLANT EVALUATION Progress Report

James H. Conley Jun. 1966 18 p refs

(CCL-205; AD-635223) CFSTI: HC $6.00/MF $0.50

The object of the study was to make a preliminary investigation of the temperature-flow-corrosion unit as a tool for the laboratory testing of automotive coolants. Nine 500 hour tests were conducted using antifreeze meeting federal specification O-A-548A with and without added inhibitors. Results correlating those received in simulated service and glassware bench tests were obtained in three instances. Mechanical failure and improper functioning of electronic instruments minimized the use of values received in the other six tests. Results of the study indicate that the temperature-flow-corrosion unit has the capability of properly evaluating coolants and will serve as a valuable research tool in heat transfer studies. Author (TAB)

N66-35652*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

RESEARCH AND ADVANCED DEVELOPMENT. VOLUME I: SUPPORTING RESEARCH AND TECHNOLOGY FOR THE OFFICE OF SPACE SCIENCES AND APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Semiannual Review, Jan. 1–Jun. 30, 1966

Frank E. Goddard, Jr. 31 Jul. 1966 413 p refs

(Contract NAS7-100)

(NASA-CR-77557; JPL-TM-33-296) CFSTI: HC $4.62/MF $2.25 CSCL 14B

Articles dealing with specific subjects in the fields of lunar and planetary exploration, physics and astronomy, bioscience, and the space sciences are presented. Included under space chemistry are articles on spectroscopy, interferometry, X-ray diffraction, and geological sampling. Works on pulse height analyzers, microwave research, optical and radio astronomy, planetology, and planetary atmospheres are given. Various aspects of planetary quarantine sterilization are discussed. Numerous developments in spacecraft and capsule equipment are treated. Other works deal with spacecraft reliability, testing, and advanced planetary and interplanetary probes. Discussed under physics and astronomy are magnetodynamics, radiation and aurora experiments, and data on fields and particles. Environmental biology, exobiology, an automated biological laboratory, and various aspects of planetary quarantine sterilization are treated under bioscience. Additional articles on spectral photography, X-ray diffraction, radiometry, and thermal emission are given in reference to planetology. K.W.

N66-35670# Weapons Research Establishment (Australia).

FLOW CALIBRATION IN THE BLOWDOWN WIND TUNNEL S3

M. L. Robinson Mar. 1966 31 p refs

(WRA-HSA-115) CFSTI: HC $2.00/MF $0.50

The distribution of Mach number in the 7 in. × 6 in. working section of wind tunnel S3 has been measured at nominal Mach numbers of 2.8, 4.0 and 5.0. Detailed results are presented in graphical form, and mean Mach numbers and variations from the respective means are tabulated. Comparison of the calibration results from S3 tunnel with those from other supersonic wind tunnels shows that the uniformity of the flow in S3 tunnel is relatively good. The mean deviation of Mach number in the working section is 0.3% for the Mach number 2.8 and 4.0 nozzles and 0.6% for the Mach number 5.0 nozzle. Design ordinates for the existing nozzle blocks are given.

Author

N66-35702# Royal Aircraft Establishment, Farnborough (England).

A SIMULATOR FOR A GRAVITY GRADIENT SATELLITE AND ITS USE FOR THE DEVELOPMENT OF A DAMPING GYROSCOPE

W. A. Ware and N. S. Reed Mar. 1966 50 p refs

(RAE-TR-66108) CFSTI: HC $2.00/MF $0.50

The simulator provides performance data on a two gyro semi-passive damping system, as envisaged for an earth oriented communication satellite with gravity gradient control. The simulator consists of a mechanical model scaled in inertia, with the motions speeded up by a factor of 1440. The data was used to design a damping type gyroscope. A reduction of satellite attitude oscillation by a factor of 8 per orbit is given by two gyros of small size. Author

N66-35744# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.

A MECHANICAL SHOCK PULSE SURVEY

Francesco Palmisano and Louis Leo Kaplan Mar. 1966 44 p refs

(ECOM-2647A; AD-627467)

A survey of the shock pulse shapes produced by mechanical shock machines used in the evaluation of electronic piece parts is discussed. The machines include free-fall, pendulum, and cam-activated types. The shock pulses range in nominal time duration of the major positive pulse from 0.60 to 32.00 milliseconds and peak amplitudes from 40 to 1150 gravitational units. Details of the recording and instrumentation techniques are presented. Instrumentation calibration and problems of undershoot are also discussed, as is the reduction of the raw data. The methods of analysis, quantitative and qualitative, of the shock pulse curves were to first determine shock pulse curve's amplitude–frequency spectrum by use of a special purpose analog computer which is designed specifically to compute Fourier integrals. The frequency spectrum is then converted to a Bode diagram from which a graphical comparison of the shock pulse is made. Analysis of the results

shows that major characteristics of the amplitude–frequency spectrum of each mechanical shock machine are mainly dependent on peak amplitude, shock pulse duration, and the area under the shock pulse curve. Author

N66-35799*# Ohio State Univ. Research Foundation, Columbus.

PROPOSED OPTICAL NETWORK FOR THE NATIONAL GEODETIC SATELLITE PROGRAM

Ivan I. Mueller May 1966 48 p *Its* Rept.-71

(Grant NSR-36-008-003)

(NASA-CR-77640) CFSTI: HC $2.00/MF $0.50 CSCL 22D

Lists of countries and stations that may participate in a proposed optical network for the Geodetic Satellite Program are given, along with maps of the globe pinpointing these stations. Stations listed are for the USCGS-DOD primary and secondary networks and stations collocated with this network; the NASA supported network; the DOD permanent Tranet and Tranet-Van networks, the DOD high altitude and present Secor networks, the DOD PC-1000 optical network, and the proposed networks. L.S.

N66-35906*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HIGH-VACUUM TECHNOLOGY, TESTING, AND MEASUREMENT MEETING Compilation of Papers

Washington, NASA, Aug. 1966 230 p refs Meeting held 8–9 Jun. 1965

(NASA-TM-X-1288) CFSTI: HC $6.00/MF $1.50 CSCL 14B

Papers on NASA in-house and contract efforts in high-vacuum simulation, experimentation, and measurement are presented. For individual titles see N66-35907–N66-35936.

N66-35908*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TECHNIQUES FOR SIMULATING THE SPACE VACUUM ENVIRONMENT

William F. Hardgrove *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 7–13 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The creation of ultrahigh vacuum, contamination measurement and control, and residual gas analysis are identified as the major areas of consideration in research to establish test criteria and simulation methods that will govern the vacuum environment necessary for adequate testing of spacecraft systems, subsystems, components, and materials. One of the approaches to the creation of ultrahigh vacuum—the cryosorption technique—is discussed, and the conceptual design for a cryosorption chamber is described. Contamination measurement and control procedures for space environment simulators are reviewed, and the residual gas analysis experiments to perfect the application of mass spectrometers for spacecraft test and evaluation purposes are briefly examined. H.S.W.

N66-35909*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ULTRAHIGH VACUUM RESEARCH FACILITY

James M. Bradford *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 15–17 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The 150 cubic foot Space Vacuum Facility at the Langley Research Center is described. The configuration of the chamber is discussed, and photographs of the facility are shown. H.S.W.

N66-35910*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL RESULTS OF A 1500-CUBIC-FEET UNBAKED ULTRAHIGH VACUUM SYSTEM

Thomas A. Keller and George A. Wise *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 19–25 refs (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The results of a program to convert a 1500 cubic foot vacuum chamber to a 10^{-10} torr vacuum system without using helium cryopumping or a bakeout system are assessed. The vacuum facility is described and the procedures used are discussed. It is shown that ultrahigh vacuums can be obtained with conventional practices and without bakeout of the chamber or gages. Cooling of the O-ring and cleaning attempts with electron bombardment were not effective in achieving further pressure reduction; however, it is felt that refinement of the techniques could yield an improvement of chamber ultimate pressure. H.S.W.

N66-35911*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRESSURE TIME LAUNCH SIMULATOR

Arthur D. Hofmes and Charles R. Nichols *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 27–36 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The development of a pressure-time launch simulator is discussed, and some of the tests that have been conducted in it are described. Shakedown tests determined the capabilities of the facility, and indicated that the facility design criteria for providing operating pressures for an ion thrustor five minutes after start of pumpdown had been met. A pressure of 2.6×10^{-5} torr was achieved two minutes after start of pumpdown. The effectiveness of SERT payload design modifications were verified. Structural weakness of the fiberglass honeycomb nose shroud material was proved, and the utility of a subliming compound as a thermal shield was demonstrated. H.S.W.

N66-35912*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VACUUM SYSTEM FOR THE BOILING LIQUID-METAL HEAT TRANSFER FACILITY

Donald E. Groesbeck *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 37–45 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The vacuum system used for providing a clean, oxygen-free environment for the columbium-1, zirconium portion of the boiling liquid metal heat transfer facility is described. The facility is composed of two practically identical loops; one loop transfers heat to the other within a counterflow, tube-within-a-tube heat exchanger. Facility components are discussed, the detection of leaks in the system is treated, and photographs of the facility are shown. H.S.W

N66-35913*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPACE SIMULATION AND FULL-SCALE TESTING IN A CONVERTED FACILITY

John H. Povolny *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 47–60 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Tests were conducted on a Centaur vehicle, to evaluate the performance of the various vehicle subsystems under simulated thermal conditions encountered during the coast phase of flight, in a space simulation chamber which was converted from a former wind tunnel complex. The chamber conversion is discussed briefly, and the Centaur nose faring separation tests are examined. The results of these tests point out the value of full scale environmental test chambers in the development of flight hardware. H.S.W.

N66-35914*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SMALL GLASS SYSTEMS—A COMPARISON WITH METAL SYSTEMS

Ilmars Dalins *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 61–69 refs (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The advantages and disadvantages of using glass components in ultrahigh vacuum systems in connection with surface physics research are discussed. The discussion covers transparency, electrical insulation properties, leak detection, fabrication, chemical resistence, fragility, tolerances, and helium permeability. It is stated that glass systems have special features which should not be overlooked. In various preliminary tests when the exact geometry and number of electrical feedthroughs may change, or when there is a definite requirement for visual observation, glass ultrahigh vacuums are advantageous. The limited acceptance of these vacuum systems is linked to fragility of glass and the difficulties in holding tolerances in the fabrication processes. H.S.W.

N66-35915*# National Aeronautics and Space Administration, Washington, D. C.

LARGE SCALE CHAMBER REQUIREMENTS

Norman A. Crone *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 71–73 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Efforts to obtain efficient utilization of existing vacuum chamber resources through cooperative planning are described. The projected gap in vacuum facility is attributed to the present ground testing philosophy which requires full scale operational systems testing, with astronauts, in the simulated space or lunar surface environment. A project is described for developing a suitable space simulation chamber known as the 220' diameter Mark II chamber. Development of standards of reference by government and industry is stressed as a factor in deciding whether any larger vacuum chambers will be required. S.P.

N66-35916*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A SURVEY OF VACUUM TECHNOLOGY RELATED PROGRAMS OF AERO-ASTRODYNAMICS LABORATORY

James O. Ballance *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 75–90 refs (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Rarefied gas dynamic studies, environmental measurements at ultrahigh altitudes, and aerodynamic testing facility improvement studies are briefly surveyed with respect to their application in vacuum technology. Gas dynamic studies are reported on free molecular flow and transition flow, with a close look at the parameters that define the flow; probe response in free molecular flow; molecule-surface interaction; theories and experiments for drag coefficients; and jet-spreading at orbiting altitudes. Two new vacuum instruments for use in environmental measurement are described; one probe is a cylinder with an orifice at one end behind which is an omegatron-type spectrometer, which alternately scans for oxygen and nitrogen. A second system being considered is a cryogenically-cooled collection device used as a type of McLeod gauge. Aerodynamic facility improvement studies focus on the development of an impulse base heating technique to determine the base heating ratio on Saturn type launch vehicles. S.P.

N66-35917*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SOME SPECIAL DESIGNS FOR UHV APPLICATIONS

Ilmars Dalins *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 91–94 refs Prepared in cooperation with Ala. Univ. Res. Inst. (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50
(Contract NAS8-2585)

The design and development of a chopper for a molecular beam apparatus is discussed. It was found that the combined use of nickel, 304 stainless steel and a low vapor pressure brazing material enables construction of vacuum components that are compatible with ultrahigh vacuum operation. This combination produces a reliable and compact chopper design that can be used to modulate a molecular beam, even in a compact all-glass or metal vacuum chamber. H.S.W.

N66-35920*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

REPORT ON A DIFFUSION PUMP EXPLOSION AT GSFC

Russell T. Hollingsworth *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 107–116 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The explosion occurred within one of the two diffusion pumps on the large vacuum facility. Although the cause has not been determined, several recommendations were made during the preliminary investigations. First, it was recommended that the investigation be continued to determine if there were any contaminants present; second, investigate reactions involving perfluorocompounds, magnesium, and/or aluminum; and third, investigate the possibility of obtaining an exothermic DC 704 fluid reaction at low pressure and elevated temperature in a large volume system. H.S.W.

N66-35921*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PROGRESS OF THE LANGLEY RESEARCH CENTER VACUUM MEASUREMENT PROGRAM

Paul R. Yeager *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 117–128 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The progress made between 1963 and 1965 in the field of vacuum technology is summarized. Efforts in research programs were directed towards improving both total- and partial-pressure measurement capability. The improvements in vacuum gage calibration facilities are discussed and various pressure measurement devices are described. H.S.W.

N66-35925*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

STATUS REPORT: MANNED SPACECRAFT CENTER CHAMBERS "A" AND "B"

William K. Roberts *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 151–164 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Dimensions and operational characteristics of chambers being constructed for space environment simulation facilities are summarized. Chamber A, the space and lunar surface environment simulation chamber, is a stainless steel vessel 65 feet in diameter by 120 feet high with a side loading door 40 feet in diameter. When completely operational, this chamber will have solar simulation, which consists of a modular top sun and side sun system simulating the thermal flux of the sun (Johnson Curve). Chamber B, which is the space chamber for life systems and astronaut training, is relatively smaller than Chamber A. The top head can be removed for loading and unloading. Acceptance test results of chamber vacuum integrity, manlock vacuum integrity, and emergency repressurization are reported. Characteristics are also tabulated for a chamber being constructed as a bottom loading single-wall facility that will operate at 5×10^{-12} torr. S.P.

N66-35926*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SPACE MOLECULAR SINK SIMULATOR

James B. Stephens *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 165–168 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

A space molecular sink simulator (MOLSINK) is described in which problems of spacecraft self-contamination, surface degradiation, and contaminant migration problems can be investigated. The MOLSINK system is an extreme-high-vacuum chamber with walls that cryogenically and chemically pump gases produced by the test item. Briefly, the workings of the simulator are that the lower part of the outer chamber and the vacuum tight inner liner can be lowered by the hydraulic lift and the molecular trap array can be removed by the overhead winch. The outgassing rate of the test item is monitored with a 4°K cryogenic quartz crystal microbalance; and the titanium sublimator, which is monitored and controlled by a 300°K quartz crystal microbalance, is made to match this gas load with an appropriate titanium sublimation rate. A shuttered 12-inch diameter double sapphire window is provided in the top of the chamber through which a high-intensity solar simulator can impinge its beam upon the test item. S.P.

N66-36010# Interior Dept., Washington, D. C. Bureau of Sport Fisheries and Wildlife.

BIOLOGICAL CONTROL OF BIRDS IN AIRPORT ENVIRONMENTS Interim Report, 29 Jul. 1964–30 Jun. 1965

John L. Seubert Jan. 1966 53 p Sponsored by FAA (RD-66-8)

Research on the bird-plane hazard problem continued. Since 1961, four aircraft crashes resulted from bird collisions. Commerical carriers reported 413 bird-plane strikes in 1964. Most strikes occurred during takeoffs and landings, and involved engines, wings, or windshields. Gulls and waterfowl were the main hazards. Bird strikes were associated with 162 U.S. and 39 foreign airports since 1961. Egg breaking and spraying eggs with an oil-formaldehyde-water mixture were about equally effective in reducing herring gull production. Gull populations that are denied food move many miles to new sources. Studies of gull population dynamics indicate that error inherent in banding data renders them meaningless for measuring survival. A starling problem was solved at Hanscom Air Force Base, Massachusetts, by using an experimental contact avicide. Improved instrumentation permitted more exacting analyses of similarities and differences between sounds of Electra engines and singing insects. Starlings did not appear attracted to a variety of amplified sounds, including those of insects and Electra engines. Author

N66-36056*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

R-F SIMULATOR FOR A LONG-PULSE RADAR

Edward L. Arnn, Jr. Jun. 1966 14 p (Grant NsG-234-61) (NASA-CR-77798; ESL-TM-273) CFSTI: HC $1.00/MF $0.50 CSCL 17I

An X-band radar target simulator possessing spectral purity, frequency stability, and precise calibration of output power is described. The simulator provides outputs at 9.720 Gc/s and 30 Mc/s and is tunable over a 1.2 Mc/s range. Output power is variable from -75 db_m to -115 db_m with an absolute accuracy of ± 0.6 db. Frequency stability at X-band is 1 part in 10^8/hr. Author

N66-36278# Argonne National Lab., Ill.

A FACILITY FOR STUDYING ELASTIC MODULI AS A FUNCTION OF TEMPERATURE BY AN ULTRASONIC METHOD: MEASUREMENTS ON VANADIUM-20 w/o TITANIUM

Ronald G. Peterson Feb. 1966 18 p refs (Contract W-31-109-ENG-38) (ANL-7119) CFSTI: HC $1.00/MF $0.50

A facility used to determine ultrasound velocities in materials at temperatures up to around 1000°C is described. The way to compute the elastic constants of a material from these velocities is shown. Results of measurements made upon V-20 wt % Ti are given. Author (NSA)

N66-36322*# General Electric Co., Ithaca, N. Y. Electronics Lab.

VISUAL THREE-VIEW SPACE-FLIGHT SIMULATOR Final Report

1 Aug. 1964 33 p refs (Contract NAS9-1375) (NASA-CR-65501) CFSTI: HC $2.00/MF $0.50 CSCL 14B

The design, fabrication, and assembly of a visual attachment to a space vehicle simulator is summarized. The visual attachment consists of a special purpose digital computer, three color television display units, and an optical system for viewing these displays. The optical system consists of three wide angle window simulators and celestial sphere which operates a realistic starfield simulation. System components such as the display computer, interface units, displays and monitors, window simulators, celestial sphere, and window support structures are described. Component photographs and diagrams are presented, and the results of a study of round-off errors for a computational method of finding the components of a point or vector after coordinate rotation are given. A.G.O.

N66-36362# European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Apparatus Div.

PRECISION SERVO—N.M.R. FIELD MEASURING EQUIPMENT FOR THE CERN MUON STORAGE RING

R. Armstrong Brown 28 Mar. 1966 36 p refs (CERN-66-15)

Features of precision servo-magnetometer, NMR, field measuring equipment for the CERN muon storage ring are described. The probe circuit, the main unit, the lock loop, and the search loop are discussed. Loop gain and stability considerations, and monitoring conditions are also discussed. Associated equipment for which features are described, are the power supplies, the comparator system for field mapping, actuators, interlocks, and remote controls. Mathematical corrections for the absolute field are discussed. Schematic and circuit diagrams of the servo-magnetometer, probe, comparator, and main unit are presented, along with photographs of the probe and main unit. L.S.

N66-36375# Federal Aviation Agency, Washington, D. C. Library Services Div.

ACCESS TO AIRPORTS—SELECTED REFERENCES

Louise K. Annus comp. Aug. 1966 11 p refs *Its* Bibliog. List No. 12

This partially annotated bibliography contains 38 references to literature concerning air, motor, rail, and water transportation to domestic airports. H.S.W.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-35357# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LAMINAR BOUNDARY LAYER ON A SUBLIMABLE SURFACE

B. V. Alekseyev 17 Jan. 1966 19 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 3, 1964 p 512–524

(FTD-MT-65-145; AD-634832) CFSTI: HC $1.00/MF $0.50

This work is dedicated to formulation and analysis of a chemically nonequilibrium boundary layer on a sublimable surface. There is performed comparison of results of analysis of a chemically non-equilibrium boundary layer with corresponding results obtained during use of concepts of frozen and equilibrium boundary layers. All calculations are conducted for the example of a body consisting of graphite.

Author (TAB)

N66-35480# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.

PRESSURE DISTRIBUTION ON TOWED AND PROPELLED STREAMLINE BODIES OF REVOLUTION AT DEEP SUBMERGENCE

John L. Beveridge Jun. 1966 31 p refs

(DTMB-1665; AD-635464) CFSTI: HC $2.00/MF $0.50

Measured and computed pressure distributions were obtained for a well-streamlined body of revolution (fineness ratio of ten to one), with and without a propeller, at deep submergence. Velocity distributions over the surface of the body with and without an added boundary-layer displacement-thickness are obtained from the velocity-potential function for a surface distribution of sources. Propeller-induced velocities in the near field ahead of a propeller are estimated from a uniform sink-disk representation and a single sink representation is used for large distances from the propeller. Propeller interference (image) effects are obtained from discrete singularities placed along the body axis. Within the field of propeller influence, differences occur in the theoretical and experimental pressure distributions. These discrepancies are discussed. Author (TAB)

N66-35484# IIT Research Inst., Chicago, Ill.

FLUERICS: 20. STUDIES ON TWO-DIMENSIONAL TURBULENT JETS Summary Report

Dennis W. Prosser and Michael J. Fisher Washington, D. C. Harry Diamond Labs., Apr. 1966 112 p refs

(Contract DA-49-186-AMC-192(D))

(AD-635195) CFSTI: HC $3.00/MF $0.75

The report summarizes the results of an investigation on noise problems associated with the operation of single-stage proportional amplifiers. Specifically concerned are the numerical values of signal and noise in terms of momentum flux for flow through a slightly blocked receiver. The theoretical approach developed for determining these values was verified experimentally. The major results show that (a) with the receiver held stationary in the power jet, the noise-to-signal ratio at the receiver entrance is minimized by keeping the receiver near the centerline of the power jet; and (b) with the receiver moving relative to the power jet, the ratio of noise to change in signal is minimized by keeping the receiver away from the power-jet axis. Author (TAB)

N66-35548*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A UNIFIED TREATMENT OF TURBULENT FLUXES IN MULTI-COMPONENT AND HOT FLOWS

F. R. Krause and M. J. Fisher (IIT Res. Inst.) *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 11–25 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

A unified treatment was developed to predict turbulent fluxes in hot and multicomponent flows around launch vehicles by writing all motion equations in terms of a single conservation law for fluid particles. The macroscopic volume concentrations and the molecular fluxes of the conservative property were then obtained by an ensemble average over the velocity distribution function of a single molecule. The discussions of turbulent fluxes for incompressible or one component compressible flows were extended to multicomponent and hot flows by applying time-averaging procedures to the general conservation law. It is pointed out that in compressible flows, most turbulent fluxes are estimated from the driving concentration gradient and the spreading rate of the concentrations profiles. By writing the general conservation law as a diffusion equation in a moving frame of reference, it was shown that the same procedure can be used in multicomponent and hot flows as long as (1) volume concentrations are used instead of mass fractions, (2) all concentration profiles are self similar, (3) all temporal fluctuations are convected as an almost frozen pattern and appear relatively small. L.E.W.

N66-35562# General Electric Co., Philadelphia, Pa. Missile and Space Div.

MOMENT METHODS IN RADIATIVE TRANSFER PROBLEMS

M. P. Sherman Jun. 1966 42 p refs

(Contract Nonr-4188)

(R66SD30; AD-635154) CFSTI: HC $3.00/MF $0.50

Half of the equations obtained from the radiative transfer equation by use of any moment approximation are unstable. Small changes in choice of the unknown boundary values give rise to large changes in the solution. In this work the cause of this difficulty is isolated and the problem overcome. The techniques developed give new insight into the moment approximations. The complex boundary conditions derived by Krook for the full moment approximations have a simple meaning in transformed variables. A comparison is made of the accuracy of full and half moment approximations using several examples. The first full moment (Eddington) approximation is found roughly comparable to the first half moment approximation, the second full moment to the second half moment approximation. Author (TAB)

N66-35619# Pennsylvania State Univ., University Park. Dept. of Aeronautical Engineering.

NON-NEWTONIAN EFFECTS ON THE TURBULENT ENERGY SPECTRUM FUNCTION

Kirtan Singh (Ph. D. Thesis) Mar. 1966 200 p refs

(Contract Nonr-656(33))

(Rept.-1; AD-635524) CFSTI: $4.00/MF $1.25

Working with the isotropic homogeneous flow of second order fluids and assuming the turbulence Reynolds number to be very large, some features of the turbulent energy spectrum are investigated theoretically. Instead of working with the equation for the fluctuating energy of the turbulent flow, the fluctuating velocity is split into a macro component and a micro component associated respectively with eddies larger and smaller than a given size, and the energy equation for the micro component of velocity is derived. Terms representing interation between large and small eddies are then simplified by assuming that the departure from isotropy of the small eddies depends on the history of deformation of the large eddies. This equation is further simplified by assuming the existence of an equilibrium range. A change of variable converts this into an integral equation whose approximate solution is found by the method of iteration. The results present an extension of the energy spectrum form due to Heisenberg and mark three divisions of the whole range of wave numbers, which may be called the inelastic range, resonance range and elastic range. Author (TAB)

N66-35621 # Ballistic Research Labs., Aberdeen Proving Ground, Md.

PARAMETRIC REPRESENTATIONS OF NON-STEADY ONE-DIMENSIONAL FLOWS

John H. Giese Apr. 1966 36 p refs

(BRL-1316; AD-635254)CFSTI: HC $4.00/MF $0.50

The determination of non-steady one-dimensional flows can be reduced to solving certain Monge-Ampere equations. Comparison of any two solutions of the same MA-equation shows that the map of one ut-plane onto the other preserves area. A classical parametric representation of all area-preserving maps can be combined with a particular solution of an MA-equation to produce the general solution. Particular solutions can easily be constructed for perfect gases and for a vast number of more general equations of state. Author (TAB)

N66-35632# Boeing Co., Wichita, Kans. Airplane Div.

WATER DROPLET IMPINGEMENT PREDICTION FOR ENGINE INLETS BY TRAJECTORY ANALYSIS IN A POTENTIAL FLOW FIELD Final Report

William F. Schmidt 29 Dec. 1965 227 p refs

(Contract NOw-65-0273-f)

(D3-6961; AD-634404) CFSTI: HC $6.00/MF $1.25

A digital computer program was developed to predict the anti-icing requirements of engine inlets by calculating water droplet trajectories toward the particular inlet through a potential flow field. The incompressible potential flow field is determined by a separate computer program using known boundary conditions. The potential flow field results are combined with the droplet and flow physical data for input to a droplet trajectory computer program. This water droplet trajectory program is based on balancing the drag, buoyancy and weight forces on the water droplet with the rate of change of the water droplet momentum. The water droplet computer program is extremely versatile because the actual design shape is used in the study and therefore the results do not need to be extrapolated. Author (TAB)

N66-35633# Boeing Co., Wichita, Kans. Airplane Div.

WATER DROPLET IMPINGEMENT PREDICTION FOR ENGINE INLETS BY TRAJECTORY ANALYSIS IN A POTENTIAL FLOW FIELD, SAMPLE PROBLEM Final Report

William F. Schmidt 29 Dec. 1965 289 p

(Contract NOw-65-0273-f)

(D3-6961-1; AD-634396) CFSTI: HC $6.00/MF $1.50

The report was written to provide a sample problem to be used to guide the user of the water droplet impingement prediction computer program. The report is intended to illustrate the preparation of input data and the interpretation of results. TAB

N66-35742# Naval Research Lab., Washington, D. C.

AN AERODYNAMIC MODEL FOR A LOW-ALTITUDE ROCKET EXHAUST PLUME

Richard Shao-Lin Lee and W. W. Balwanz (State Univ. of New York, Stony Brook) 25 Apr. 1966 32 p refs

(NRL-6386; AD-482690)

An aerodynamic model is proposed for the exhaust plume issuing from a rocket nozzle exit into quiescent ambient air in which chemical reaction or two-phase flow does not predominate. The model is based on the presently available knowledge and established aerodynamic principles for the various flow regimes involved. The major assumptions made are individually substantiated and justified by experimental evidence in existing literature. A theoretical analysis is carried over the whole flow region based on the Kármán's integral approach in the hope of finding solutions for the gross aerodynamic behavior of the plume, especially for ranges up to the full region of the plume. Solutions are matched at the boundary of the inviscid core and turbulent mixing regions. Theoretical results agree closely with related experimental data. Author

N66-35746# Case Inst. of Tech., Cleveland, Ohio. Engineering Div.

SECONDARY FLOWS ASSOCIATED WITH SLOWLY OSCILLATING AND ROTATING DISKS

R. J. Hanold and J. R. Moszynski Jun. 1966 204 p refs

(Grants NSF G-9240; NSF GP-2680)

(FTAS/TR-66-9)

A systematic study was made of the flow behavior as a function of the Reynolds number which the previous literature indicates is the critical flow parameter. The three-dimensional character of the flow is verified, and the development of a toroidal vortex both above and below the oscillating disk is illustrated. The experiments are performed in a vessel similar to a typical oscillating body viscometer. The effect of the Reynolds number on the damping rate of the disk is investigated, and the influence of natural convection flows on the magnitude and reproducibility of the damping rate is obtained. The development of a visualization technique suitable for liquid flows with velocities as low as 0.1 mm/sec. is described. This technique was employed to provide a photographic record of the flow conditions prevailing at the time of each experiment. The development of a secondary flow in the form of a toroidal vortex for both the rotating disk and rotating sphere is also illustrated. Author

N66-35809# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

FLOPSY-II: A DIGITAL COMPUTER PROGRAM FOR CALCULATING FLOWS AND PRESSURE DROPS IN HYDRAULIC NETWORKS

B. L. Strain 1 Jun. 1965 46 p refs

(Contract W-31-109-ENG-52)

(KAPL-3030) CFSTI: HC $2.00/MF $0.50

The FLOPSY-II code deals with the fluid flow distribution and pressure drop in any network of nodes and branches. It can handle either an open-loop or closed-loop circuit and variable resistances either in series or parallel. The basic equations used in the code are given, and the code is described in some detail. The input and output are described, and some sample problems are solved. NSA

N66-35868# California Univ., Livermore. Lawrence Radiation Lab.

A COMPARISON OF ANALYTICAL AND NUMERICAL SOLUTIONS FOR THE SHOCK TUBE PROBLEM

Barbara K. Crowley 21 May 1965 32 p refs

(Contract W-7405-ENG-48)

(UCRL-14198) CFSTI: HC $2.00/MF $0.50

The classical shock tube problem is discussed. Derivation of an analytical solution from the Rankine-Hugoniot relations for an ideal gas across a plane shock are reviewed. A typical shock tube with large discontinuities is chosen and simulated on various numerical finite-difference calculations. These calculations are performed in the Eulerian, Lagrangian, and Eulerian-Lagrangian coordinate frames. The results of these calculations are shown and compared with the analytical solution. They indicate that the Lagrangian approach is worth considering for problems with large discontinuities in the initial conditions. Author (NSA)

N66-35869# Oklahoma State Univ., Stillwater.

NUMERICAL SOLUTIONS OF THE FLOW FIELD PRODUCED BY A PLANE SHOCK WAVE EMERGING INTO A CROSS-FLOW

Lynn D. Tyler and Glen W. Zumwalt Aug. 1965 196 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-DC-65-1916) CFSTI: HC $5.00/MF $1.00

An analysis was conducted to determine if there existed conditions for experimental blast simulation using a shock tube mounted on the side of a wind tunnel. The primary purpose of this study was to describe mathematically phenomena of a plane shock propagating into a supersonic crossflow. A finite difference technique proposed by the Russian mathematician, Rusanov, was applied to the problems of a shock propagating from an opening into both a still and supersonic crossflow. The geometries of the openings used for the still medium problems were slit-like and circular while the opening geometry used in the crossflow problem was a long slit, i.e., the geometry was plane. A computer program, which applied the difference scheme to a 6000 point mesh, was written for a CDC 3600 computer. Results were obtained for a shock of strength 10.0 (i.e., pressure ratio) which propagated into both a Mach 2.0 and a Mach 5.0 crossflowing stream. Also, for shock strengths of 4.0 and 10.0, computations for propagation into a still medium from both of the above geometries were obtained. Author (NSA)

N66-38870# Brookhaven National Lab., Upton, N. Y. Dept. of Applied Mathematics.
ON SOME MATHEMATICAL ASPECTS OF KINETIC MODEL EQUATIONS
Lawrence Sirovich (Brown Univ.) and James K. Thurber [1965] 28 p refs Prepared in cooperation with Brown Univ.
(Contract AT(30-2)-GEN-16; Grant NSF GP-3753)
(BNL-9254) CFSTI: HC $2.00/MF $0.50

A class of integro-differential equations used in the kinetic theory of gases is investigated. Under relatively weak conditions the existence and uniqueness of solutions to the initial value problem for these equations are shown. Under somewhat stronger assumptions the validity of the application of Fourier-Laplace transforms to this problem is demonstrated. Finally the asymptotic approach to hydrodynamics is shown. Author (NSA)

N66-38014# Adelphi Coll., Garden City, N. Y. Dept. of Graduate Mathematics.
THE BOUNDARY CONDITION AT INFINITY IN THE PROBLEM OF WAVES IN A VISCOUS FLUID, PART I
Michael Yanowitch Jul. 1965 25 p refs
(Grant NSF GP-1804)
(AGM-122; PB-169108)

The problem of two dimensional horizontal oscillations of a viscous fluid in a half plane is discussed. It is shown that a correct "boundary condition at ∞" is the finiteness of the average rate of energy dissipation in a column of fluid, and that the condition of boundedness of the velocity is equivalent to this. It is also shown that there can be no resonances in the above problem. Author

N66-38017# McGill Univ., Montreal (Quebec). Hypersonic Propulsion Labs.
INTERACTION EFFECTS PRODUCED BY A VAPORIZING LIQUID INJECTED INTO A HIGH ENERGY SUPERSONIC GAS STREAM
J. E. Attas Apr. 1963 93 p refs
(Grant DRB-9550-06)
(Rept.-63-2) CFSTI: HC $3.00/MF $0.75

The possibility of obtaining side thrust by the injection of a vaporizing liquid into a supersonic high temperature flow is investigated. A simplified analytical solution is presented for the case where injection produces boundary layer separation, and for the case where the injected liquid mixes with the supersonic stream without causing it to separate. As a byproduct of this analysis, the cooling effect produced by injection can be computed. Using separation criteria for turbulent boundary layers, the side specific impulse and cooling effect produced by water injection is computed. The specific impulse is found to increase with free stream Mach number, free stream total temperature and ratio of specific heats, while decreasing slightly with injection rate. Experiments show that separation does occur and that the predicted pressure increase due to injection is easily attainable. Mixing is found to be a generally unsteady condition except at low temperatures and low injection rates. Author

N66-38038# Oklahoma Univ., Norman.
SKIN FRICTION COEFFICIENTS OF COMPLIANT SURFACES IN TURBULENT FLOW
William Robert Looney (M.S. Thesis) 1966 74 p refs
(Contract DA-31-124-ARO(D)-349)
(AD-635239) CFSTI: HC $1.50/MF $0.75

From this experiment it may be concluded that flexible boundaries seem to substantially reduce skin friction in turbulent flow. Reductions of as much as 40–50% in skin friction were found in some experimental configurations. It is not possible to state that these lower values are a sole function of any one parameter such as viscosity, lateral tension, or longitudinal tension. The data indicates that the lowest skin friction depends upon the relation between these three variables as well as the mass or thickness of the flexible membrane. The skin friction of the flexible boundaries appear to decrease as the kinematic viscosity increases, at least up to 8000 CS, the highest value tested. In general, the reduction of skin friction is accompanied by a reduction in turbulence intensity. Author (TAB)

N66-38038# Michigan Univ., Ann Arbor.
CAVITIES FORMED ON LIQUID SURFACES BY IMPINGING GASEOUS JETS
Frank Robert Cheslak (M.S. Thesis) 1966 94 p refs
(AD-635528) CFSTI: HC $3.00/MF $0.75

Assuming the jet mixes turbulently with the surrounding atmosphere, the stagnation pressure corresponding to the centerline conditions of the jet at a point of the cavity's maximum depth, i.e., height of nozzle above liquid plus cavity depth, was equated with the hydrostatic pressure at the cavity's bottom allowing a determination of the depth. The diameter of the cavity or maximum width was predicted for axisymmetric and two-dimensional jets. Prediction of minimum jet pressure required to induce liquid spray was made by an equilibration of surface tension, gravity, and drag forces. Experimental tests of air impinging on both water and wet cement were performed and analyzed along with the results of air impingement on various other liquids. The experimental cavities formed on the water were extremely irregular, however, time exposure photographs allowed detailed inspection of the steady state shape of these cavities. Cavities were also formed on wet cement and by allowing the cement to set with the air jet still impinging. Detailed measurements could be made of the solidified cavity shape. Streamline tests were then made within and above some of these cavities. Author (TAB)

N66-38040# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON SIMILITUDE OF BODIES IN A FLUID FLOW
R. I. Vinogradov 27 May 1964 17 p refs Transl. into ENGLISH from Izv. Vysshikh Uchab. Zaved., Aviats. Tekh. (Kazan), no. 4, 1962 p 3–11 refs
(FTD-MT-63-286; TT-65-63131; AD-619558) CFSTI: HC $1.00/MF $0.50

Kinematics, flow, and strains are considered in a study of similitude in natural vibrations of an elastic body in an incompressible fluid flow. The problems of creating an aircraft with a flapping wing are investigated, and the modeling involved in the development of this aircraft is presented. Modeling of the oscillation of an elastic body, free oscillations of a system with a nonelastic resistance, forced oscillations of a system, and nonlinear oscillations of a system is demonstrated, and the transition from the model to full-scale object is also discussed. A.G.O.

N66-38052*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics.

STABILITY OF HELMHOLTZ FLOW IN AN UNSTABLE ATMOSPHERE

Thomas J. Eisler Aug. 1966 16 p refs *Its* Rept.-66-011 (Grant NsG-586)

(NASA-CR-77874) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The stability of the Helmholtz profile in an atmosphere with an unstable density gradient has been studied. It is found that the convective and shear instabilities are essentially separate. It is noted that the shear gives rise to an amplified mode at right angles to the direction of the mean flow. Author

N66-38087# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

ROTATIONAL TEMPERATURE AND DENSITY MEASUREMENTS IN UNDEREXPANDED JETS AND SHOCK WAVES USING AN ELECTRON BEAM PROBE

Paul V. Marrone Apr. 1966 96 p refs

(Grants AF-AFOSR-366-64; AF-AFOSR-276-64)

(UTIAS-113; AD-482794)

An electron beam probe was used to obtain measurements of rotational temperature and gas density in supersonic nitrogen jets expanding from room temperature. The parameter P_od (where P_o is the stagnation pressure in torr, and d is the orifice exit diameter in mm) was varied from 15 to 480 toor-mm. This corresponds to a sonic Reynolds number range of 290 to 9,320. Density measurements were made using a photomultiplier with an interference filter centered at 3900 A and having a half-width of 100 A. The experimental density data follow the axial isentropic density distribution in regions of rotational nonequilibrium. Rotational temperature measurements were obtained from rotational spectra of the $N2^+$ first negative 0–0 band at 3914 A using a high dispersion spectrograph. The experimentally determined rotational temperature values follow the axial isentropic temperature distribution in a free jet down to approximately 85 K for P_od = 480 torr-mm, with a scatter of about ±3%. Below these temperatures, the rotational temperature data depart from the isentropic curve and freeze at ccconstant temperature, which is dependent on the value of P_od. A shock holder was inserted in the jet and a number of shock waves in the range M = 4 to M = 15 were investigated. Density profiles through the shock waves were obtained. Rotational spectra indicate a large departure from a Boltzmann distribution in the rotational levels in the center of a shock front. This effect is small at M = 4, but very pronounced at M = 15. An apparent non-Boltzmann rotational distribution in the jet expansion flow was also observed. Author (TAB)

N66-38102# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

THE TWO-DIMENSIONAL LAMINAR JET IN PARALLEL STREAMING FLOW

I. Wygnanski Jul. 1966 28 p refs *Its* Flight Sci. Lab. Rept. No. 107

(Grant NRC A-2600)

(D1-82-0549)

Solutions to the problem of a two-dimensional, laminar jet of incompressible fluid issuing into a uniform stream in the direction of the main flow are considered. Two coordinate-type expansions are developed. A direct expansion, when suitably transformed, predicts approximately the velocity along the plane of symmetry of the jet for all values of the abscissa, with a maximum error of 7.6% far downstream from the origin. This error is established by comparison with a second, asymptotic expansion valid only at large values of the abscissa. The two expansions are subsequently joined, permitting an approximate determination of a constant which multiplies a third order term in the asymptotic series and which initially remained unknown even after satisfying all boundary conditions imposed on these series. The decay of velocity excess along the plane of symmetry of the jet is accelerated by the presence of the external stream. Author

N66-38103# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

THE TWO-DIMENSIONAL FLOW OF AN INVISCID DENSITY-STRATIFIED LIQUID PAST A SLENDER BODY

E. W. Graham Jul. 1966 33 p refs *Its* Flight Sci. Lab. Rept. No. 108

(D1-82-0550)

Under the assumption of small velocity perturbations the linearized equation governing the two-dimensional flow of a density-stratified fluid is developed. The density is assumed to vary exponentially with depth which simplifies the equations and permits consideration of a fluid of infinite extent vertically as well as horizontally. The approximate derivation used emphasizes the physical aspects of the situation, employing the eccentricity of the center of gravity of a fluid element and the resulting torque which is developed even in the absence of viscosity. Particular attention is given to the case where gravity forces greatly exceed accelerative forces. For this case the expression for a dipole is developed and corrected to eliminate infinite energy from the upstream field. It is shown how the dipole is used to construct slender bodies, and expressions for the wave drag of slender bodies are given. The attempt is to further clarify some of the simpler aspects of stratified-fluid flow. Author

N66-38113*# Research Triangle Inst., Durham, N. C.

NONGREY RADIATION EFFECTS ON THE BOUNDARY LAYER OF AN ABSORBING GAS OVER A FLAT PLATE

A. M. Smith and H. A. Hassan Washington, NASA, Sep. 1966 109 p refs

(Contract NAS1-4270)

(NASA-CR-576) CFSTI: HC $3.00/MF $0.75 CSCL 20D

A study of the nongrey radiation effects on the laminar boundary layer of an absorbing gas over a flat plate is presented. The nongrey model employed assumes an absorption coefficient with a stepwide frequency dependence. Such a model gives a reasonable fit to the published data on monochromatic absorption coefficient for air. Examination of the optical thicknesses corresponding to the various step functions shows that the maximum optical thickness based on boundary layer thickness and maximum absorption coefficient is less than unity in the boundary layer over a flat plate. For typical temperatures and Eckert numbers at the edge of the boundary layer, it is shown that for high external flow emissivities the nongrey radiative flux to the wall is greater than the grey; while the grey convective flux is greater than the nongrey. The total heat transfer, based on the nongrey model, is found to be greater than that based on the grey model, for a combination of high wall and high external flow emissivities or, low wall and low external flow emissivities. Author

N66-36116*# Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
HYDRODYNAMICS OF TIRE HYDROPLANING
C. S. Martin Washington, NASA, Sep. 1966 70 p refs
(Grant NGR-11-002-033)
(NASA-CR-601) CFSTI: HC $2.50/MF $0.75 CSCL 20D

The hydrodynamics of pneumatic tire hydroplaning are explained from a purely analytical standpoint. Lift and drag forces on an assumed planing surface (tire) are obtained for an ideal fluid undergoing two-dimensional motion. For the condition of incipient hydroplaning the theoretical lift coefficient is found to be 0.8, compared to a value of 0.7 from experiment. The lift and drag coefficients are shown to decrease as the tire lifts further off the runway. The pressure distribution on the pavement from theory compares favorably with the experimental results. Author

N66-36126*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WEAK LOCALLY HOMOGENEOUS TURBULENCE IN IDEALIZED FLOW THROUGH A CONE
Robert G. Deissler Washington, NASA, Sep. 1966 29 p refs
(129-01-09-07-22)
(NASA-TN-D-3613) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Turbulence in idealized flow through a cone is analyzed by using generalized twopoint correlation equations that are based on the Navier–Stokes and continuity equations. Viscosity and the effects of mean strain are retained in the analysis, but the turbulence is assumed to be weak enough to neglect the triple correlation terms in the equations in comparison with the other terms. Components of the turbulent velocity and vorticity variances, as well as the spectra of those quantities, are calculated. A mean-strain energy-transfer term in the spectral equation which transfers energy components between wave numbers is also considered. By using the momentum-heat-transfer analogy, the results are related to heat transfer between the fluid and the cone wall. Author

N66-36129*# Aero Vac Corp., Troy, N. Y.
VACUUM TECHNOLOGY AND SPACE SIMULATION
Donald J. Santeler, David H. Holkeboer, Donald W. Jones, and Frank Pagano Washington, NASA, 1966 331 p refs
(Contract NASw-680)
(NASA-SP-105) CFSTI: HC $7.00/MF $1.75 CSCL 20D

A comprehensive manual covering the state-of-the-art of vacuum technology applied to space simulation is presented. The essential specifics of vacuum technology are discussed and include vacuum nomenclature, pressure, pressure gauges, pumping speed, gas flow in components and systems, pumping systems, cryogenic pumping, gas load, outgassing of materials, space simulation and vacuum systems, and leak detection. R.N.A.

N66-36140*# National Aeronautics and Space Administration, Washington, D. C.
BOUNDARY LAYER RELATIONSHIPS RESULTING FROM AN APPROXIMATION OF THE VISCOSITY OF EQUILIBRIUM DISSOCIATING AIR [ZAKONOMERNOSTI POGRANICHNOGO SLOYA, VYTEKAYUSHCHIYE IZ APPROKSIMATSII VYAZKOSTI RAVNOVESNO DISSOTSIIRUYUSHCHEGO VOZDUKHA]
Yu. A. Dem'yanov and I. N. Murzinov Sep. 1966 9 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 5, 1965 p 971–972
(NASA-TT-F-10292) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Discussion of the relationship between the viscosity laws of a perfect gas and equilibrium dissociating air. It is shown that if the enthalpies and velocities on the outer boundary of the boundary layer and the wall enthalpies for a perfect gas and for equilibrium dissociating air coincide, then the friction and heat-transfer characteristics coincide for both viscosity laws. Author

N66-36245# Columbia Univ., New York. Plasma Lab.
AN ELEMENTARY NUMERICAL TREATMENT OF THE BOLTZMANN EQUATION FOR A SIMPLE GAS WITH PARTICULAR ATTENTION TO WALL INTERACTION
Harold G. Elrod May 1965 51 p refs
(Contract AF 49(638)-1254)
(Rept.-17; AD-618043) CFSTI: HC $3.00/MF $0.75

Analysis of numerical experiments connected with solution of the Boltzmann equation for a simple gas are described. Efforts are directed towards providing a better understanding of kinetic theory predictions for flow phenomena near a wall. TAB

N66-36277# Argonne National Lab., Ill.
FLOW-REGIME TRANSITIONS AT ELEVATED PRESSURES IN VERTICAL TWO-PHASE FLOW
James L. L. Baker (Ph.D. Thesis—Illinois Univ.) Sep. 1965 148 p refs
(Contract W-31-109-ENG-38)
(ANL-7093) CFSTI: HC $4.00/MF $1.00

Two-phase flow-regime transitions at elevated pressures for a single-component fluid, trichloromonofluoromethane (Refrigerant-11), were investigated for forced-circulation, upward flow in a vertical, rectangular conduit with internal dimensions of 0.380 by 1.050 in. The two-phase mixture was generated by an electrically heated tube at a constant heat flux. The orthobaric-density ratio ranged from 7 to 60. The mass qualities based upon thermodynamic equilibrium ranged to 90%; however, most of the data encompassed the segment from saturation to 50%. The flow regimes were observed in the unheated rectangular section by employing an X-ray and television monitoring system. Three principal flow regimes were delineated: churn, annular, and wispy-annular flow. The plug-flow regime was not observed at elevated pressures. For comparison of fluids as widely divergent in their physical properties as R-11 and water, identical orthobaric-density ratios were more suitable than reduced temperature or reduced pressure. Expressions were developed to correlate surface tension and liquid dynamic viscosity for refrigerants and water as a function of reduced saturation pressure. Through an examination of these correlations of orthobaric properties, a simplified modeling of the flow-regime transitions was possible. A comparison of the saturation properties of R-11 and water at constant orthobaric-density ratio revealed that the ratios of the various properties were relatively constant over the range of test conditions. An examination of the Taylor-Helmholtz and Kelvin-Helmholtz stability criteria for flow-regime transitions yielded results that closely bounded the result from consideration of a purely inertial system. Local void-fraction distributions were obtained for six orthobaric-density ratios by employing a gamma traversing unit. The average void fractions were compared to available void data for water and a refrigerant, R-22, at identical orthobaric-density ratios. Agreement within the data was found. However, none of the existing correlations predicted the results over the entire range of quality and mass flow rate. An expression for the average void fraction was obtained for mass flow rates below 0.70×10^6 lb/hr-sq ft. Author (NSA)

N66-36282# Los Alamos Scientific Lab., N. Mex.
A TWO-DIMENSIONAL TIME-DEPENDENT NUMERICAL STUDY OF ROTATIONAL COUETTE FLOW

Kenneth A. Meyer (Ph.D. Thesis—Stanford Univ.) 26 May 1966 174 p refs
(Contract W-7405-ENG-36)
(LA-3497) CFSTI: HC $5.00/MF $1.00

Finite difference techniques were applied to the study of two-dimensional time-dependent rotational Couette flow, developing into Taylor vortices. A set of finite difference equations utilizing the stream-function to satisfy continuity was developed and their accuracy and stability were considered. Investigations included a comparison with a second system of difference equations using velocities rather than the stream-function and a study of the effect on accuracy of varying both the spatial and time increments. The effect of the form of the difference approximation to the radial boundary conditions was considered and the problem of choosing the wavelength for the periodic axial boundary condition is discussed in detail. The system of difference equations was judged quite adequate for the proposed hydrodynamic study. A series of problems with varying Reynolds numbers was considered for a configuration with a radius ratio of outer to inner cylinder of 1.2, with the outer cylinder stationary. The critical Reynolds number for onset of Taylor vortices ascertained was in good agreement with linear theory. It was found that for the steady secondary flow there is a preferred vortex axial wavelength which depends on Reynolds number. In a second series of problems comparison was made with analytic results of Davey and experimental results of Donnelly and Simon. Davey's analysis assumes that the wavelength is as given in the linear theory; his analysis agrees with the experiments only very close to the critical Reynolds number. It was found that by using this axial wavelength the numerical results agreed with Davey's theory; however, by allowing the wavelength to vary with Reynolds number, good agreement with the experimental torque values was obtained over a wide range of Reynolds numbers. Within the context of numerically obtained "preferred states" the previously conjectured principle of maximum dissipation was shown not to apply. The numerical results provide insight on the possible cause of the second (circumferential) instability. Some results concerning flows between counterrotating cylinders were also obtained.

Author (NSA)

N66-36297# Lockheed Missiles and Space Co., Palo Alto, Calif.

APPROXIMATE METHOD OF INTEGRATING THE LAMINAR BOUNDARY LAYER EQUATIONS

A. Sh. Dorfman [1966] 12 p Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), v. 2, no. 6, 1966 p 112–121

Integral methods based on utilizing the momentum integral relation are applied customarily for the analysis of a boundary layer, with an arbitrary velocity distribution in the external flow. Since the velocity distribution in the boundary layer should be selected in advance, another approximate method of solving the proposed problem is based on linearizing the boundary layer equations in the Mises form. Relationships connecting the velocity distribution in the boundary layer and the friction stress on the wall to the velocity distribution function in the external flow and to its derivatives are established as a result of integrating the linearized equation. The Mises equation is presented, and reasons for its linearization are expressed. A solution of the equation is derived, and the friction stresses on the wall are determined. The obtained results are applied to cases of the power law and the linear law of the velocity change in the external flow, for which exact solutions are known. S.P.

N66-36361# Institut Für Elektronen und Ionenforschung, Munich (West Germany).

EXPLICATION OF THE SCATTERING INTENSITY OF THE INTERACTION OF MOLECULAR BEAMS WITH SOLID BODY BY MEANS OF WAVE MECHANICS [WELLENMECHANISCHE DEUTUNG DER BEI DER WECHSELWIRKUNG VON MOLEKULARSTRAHLEN MIT EINER FESTKOERPEROBERFLAECHE ERZEUGTEN STREUVERTEILUNG]

A. Nikuradse and J. Weidner 1966 75 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-37) CFSTI: HC $3.00/MF $0.75

Researches in our institute show the dependence of forward-scattering of reflected molecular beams of rarefied gases on kind and state both of the gas and the reflecting solid body. The present paper regards the molecular structure of gas and solid body, trying to explain the measurements by theory. As the interaction takes place within atomic dimensions, wave mechanics should be applied. The lattice constant of the solid body was supposed to be much larger than the dimensions of the interacting particles. According to the interaction potentials, the intensity distribution yields either a cardioide (Dirac function, hard impacts), or an ellipse, similar to the experimental curves. Author

N66-36398# Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena.

HIGH SPEED PHOTOGRAPHIC STUDIES OF ULTRASONICALLY-INDUCED CAVITATION AND DETAILED EXAMINATION OF DAMAGE TO SELECTED MATERIALS Technical Report No. 2

Hilding Gunnar Olson (Ph.D. Thesis) Aug. 1966 326 p refs
(Grant NSF GK-730)
(Rept.-07738-2-T)

An investigation is presented of cavitation as induced by high frequency vibration in water, and comparisons are given of data accumulated from venturi and previous vibratory experiments. High speed photographic techniques were developed and used to study the bubbles that make up the ultrasonically-induced cavitation cloud. Individual cavitation pits, obtained on specimens chosen to represent a wide range of mechanical properties, were examined metallographically and their profiles traced. Thin foils were exposed to cavitation in an effort to learn more about basic damage mechanisms. Photographic proofs show that most bubbles in a cavitation field are expanded and collapsed in one acoustic cycle. Three models are hypothesized to explain the existence of the various types of cavitation bubbles and to suggest a possible damaging mechanism. It is thought that the normal bubble collapse mode is toroidal which suggests that those investigations that assumed spherically symmetrical collapses have incurred an error both in collapse times and predicted pressure pulses from the collapses and rebounds. Individual pits on the foils appear to be the result of a single impact. An attempt was made to correlate mean depth of penetration, depth to diameter ratio, and bubbles/pit ratios to various mechanical properties. C.T.C.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-35370# RAND Corp., Santa Monica, Calif.
GROUND-LEVEL MAGNETIC FLUCTUATIONS DUE TO HIGH-ALTITUDE NUCLEAR BURSTS OR IMPULSE SOURCES OF NATURAL ORIGIN
E. C. Field and C. Greifinger May 1966 44 p refs
(Contract ARPA SD-79; ARPA Order 189-1)
(RM-4946-ARPA; AD-635285) CFSTI: HC $2.00/MF $0.50

The memorandum is part of a continuing study of the detection of high-altitude nuclear explosions. It is concerned with low-frequency hydromagnetic waves generated by such explosions and detected at worldwide locations. It should be of interest to those concerned with ground-level magnetic signals generated by either high-altitude nuclear bursts or sources of natural origin.
Author (TAB)

N66-35378# Joint Publications Research Service, Washington, D. C.
THE THEORETICAL PROBLEMS ON THE DETERMINATION OF SEA GRAVITY BY USING A HIGH DAMPING GRAVIMETER
Hsi-Ch'i Li *In its* Transl. on Communist China: Sci. and Technol., No. 337 19 Aug. 1966 p 1-19 refs Transl. into ENGLISH from Ts'e-Liang Yu Ti-Ch'iu Wu-Li Chi-K'an (Peking), no. 2, Nov. 1965 p 27-37 (See N66-35377 21-34) CFSTI: $2.00

The effects of disturbing acceleration on the readings of a gravimeter are discussed, and a method is proposed for avoidance of the hysteresis produced by strong damping forces. The motion of a gravimeter mounted on gimbals is considered as the motion of a rigid body around a fixed point. Correction terms needed to compensate observations of disturbing acceleration is excess of 20 gal. made with gravimeter mounted on gimbals are discussed. The use of spinning top pendulum for sea gravity measurement is described. The conditions necessary for eliminating effects of horizontal acceleration and the inclination of the instrument are presented. It is stated that the spinning top pendulum can be free of the effect of horizontal acceleration less than 100 gal. without requiring any correction factor.
S.P.

N66-35381# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A FERRITE-TRIODE PRINTED CIRCUIT CARD, CONTROLLED BY A TRIGGER
N. A. Yarmosh 11 Feb. 1966 14 p refs Transl. into ENGLISH from the book "Ferrity i Beskontaktnyye Elementy" Minsk, Izd. AN BSSR, 1963 p 390-398
(FTD-MT-65-200; TT-66-61652; AD-635006) CFSTI: HC $1.00/MF $0.50

The paper describes a logical circuit of a ferrite-triode card controllable by a trigger which may be used as a basic element in an electronic computer.
TAB

N66-35488# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME II, NO. 4, FOURTH QUARTER 1965
Anne L. Carrigan and Norman J. Oliver, ed. 1965 259 p refs
(AD-634824) CFSTI: HC $6.00/MF $0.50

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N66-35487# Weston Observatory, Mass.
TOTAL FIELD INTENSITY MAGNETOMETER
John F. Devane *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 3-10 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Tabulated total field intensity magnetometer data for 1965 are presented. The data were obtained from the Weston Observatory, Weston, Massachusetts.
R.N.A.

N66-35488# Brazil. Comisso Nacional de Atividades Espaciais.
TOTAL FIELD INTENSITY MAGNETOMETER
Fernando de Mendonca *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 11-14 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Tabulated total field intensity magnetometer data showing hourly values for October and December of 1965 are presented. The data were taken by the Space Physics Laboratory in Sao Paulo, Brazil.
R.N.A.

N66-35491# Air Force Cambridge Research Labs., Newburyport, Mass.
OBLIQUE BACKSCATTER RADAR
Chester Malik *In its* Geophys. and Space Data Bull, Vol. II, No. 4, 1965 p 75-89 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Auroral and oblique incidence backscatter radar records made at 19.39 MHz at Plum Island, Massachusetts from September 28 through December 14, 1965 are presented. R.N.A.

N66-35492# Air Force Cambridge Research Labs., Newburyport, Mass. Wentworth Inst.
OBLIQUE BACKSCATTER RADAR
Richard Hartke *In its* Geophys. and Space Data Bull., Vol. II, No. 4, 1965 p 91-93 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Auroral and oblique incidence backscatter radar records made at 49.620 MHz at Plum Island, Massachusetts from September 27 through October 2, 1965 are presented. R.N.A.

N66-35493# Puerto Rico Univ., Mayaguez.
OBLIQUE HIGH-FREQUENCY PROPAGATION
Braulio Dueno, Alfredo Guimaraes (Press Wireless Uruguay, Ltda), O. G. Villard (Stanford Univ.), Kirsten Folkestad (Forsvarets Forskninginstitutt), and David Davidson (Deco Electron. Inc.) *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 95-98 Prepared jointly with Press Wireless Uruguay, LTDA, Stanford Univ., Forsvarets Forskninginstitutt, and Deco Electron., Inc. (See N66-35486 21-13) CFSTI: HC $6.00/MF $0.50

Mass point plots of diurnal variations in maximum and minimum frequencies for short (50 microseconds) pulses to Maynard, Massachusetts from Mayaguezm Puerto Rico; from Standford, California; and from Andoya, Norway during October 1965 are presented. Also included are mass point plots of diurnal variations in maximum frequency, frequency band, and minimum frequency for short (50 microseconds) pulses from Mayaguez, Puerto Rico to Montevideo, Uruguay during September and October of 1965. R.N.A.

N66-35494# AirTechnology Corp., Waltham Mass.
RIOMETER
John Dulchinos *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 99-100 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Special absorption events abstracted from riometer data recorded for the period September 1 through December 31, 1965 are tabulated. The data were recorded at Bedford, Massachusetts at 22, 30, and 62.6 MHz; Hermanus, South Africa at 30 MHz; Huancayo, Peru at 30 MHz; Jamaica, West Indies at 30 MHz; Manila, Philippines at 30 MHz; Maui, Hawaii at 30 MHz; New Delhi, India at 20 and 30 MHz, Sao Jose dos Campos, Brazil at 30 MHz; and Thule, Greenland at 30 MHz. R.N.A.

N66-35501# Ionospharen-Institut Breisach (West Germany).
VERTICAL INCIDENCE IONOSPHERIC SOUNDINGS. ABSORPTION LOSS
Karl Rawer *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 195-199 (See N66-36486 20-13) CFSTI: HC $6.00/MF $0.50

Tables are presented which show daily values of absorption loss in dB at 1200 UT from vertical incidence ionospheric soundings made by the Ionospharen Institut located in Breisach, Germany during the period from October 1 to December 31, 1965. R.N.A.

N66-35502# Ionospharen-Institut Breisach (West Germany).
VERTICAL INCIDENCE IONOSPHERIC SOUNDINGS. MEDIAN VALUES
Karl Rawer *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 201-205 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Provisional median values of ionospheric characteristics derived from vertical incidence ionospheric soundings made at Freiburg, Germany at 1 to 20 MHz from October through December of 1965 are tabulated. R.N.A.

N66-35527# Pennsylvania State Univ., University Park. Dept. of Physics.
ABUNDANCE OF METHANE IN THE EARTH'S ATMOSPHERE
Uwe Fink, D. H. Rank, and T. A. Wiggins *In its* Opt. Phenomena in Liquid and Gaseous Media [1965] 10 p refs Supported in part by NSF (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

The abundance of CH_4 in the earth's atmosphere has been determined assuming an effective temperature for the atmosphere of 250°K. The lines R(0) and P(2) of the $2\nu_3$ band were used since they are sensibly single and are easily broadened so that the total integrated intensity can be determined. The result of 1.11 ± 0.16 cm-atmos. (NTP) is in good agreement with previously published results obtained using less realistic effective temperatures. Author

N66-35540# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ON THE SOLUTION OF N. MOISEYEV'S INTEGRAL EQUATION IN THE THEORY OF THE UNREGULATED FIGURE OF GEOID [UEBER DIE AUFLOESUNG DER INTEGRAL-GLEICHUNG VON N. MOISSEIEV IN DER THEORIE DER NICHTREGULARISIERTEN GEOIDFIGUR]
V. Saltykov Jun. 1966 10 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 16, no. 8, 1937 p 133-137
(ACIC-TC-1052; AD-634928) CFSTI: HC $1.00/MF $0.50

A solution is presented for Moiseev's integral equation in the theory of the unregulated figure of the geoid. Author

N66-35585# Wisconsin Univ., Madison
WINDSPEED ON MOUNTAINS Final Report, Feb. 1964-Nov. 1965
Eberhard W. Wahl 31 Jan. 1966 87 p refs
(Contract AF 19(628)-3873)
(AFCRL-66-28; AD-634877) CFSTI: HC $3.00/MF $0.75

Based on data from six German mountain observatories, the behavior of windspeed distributions on top of mountain summits has been investigated. Relationships have been established linking the occurrence of winds on the mountain to the simultaneously observed flow in the free atmosphere at summit height in the vicinity. Since the windspeed data can be represented satisfactorily by means of double exponential distribution functions, a method of estimating the occurrence of high windspeeds based on these distributions has been developed. Author (TAB)

N66-35602*# Geological Survey, Washington, D. C.
PHOTOGRAMMETRIC MAPPING OF EXPERIMENTAL CRATERS
R. V. Lugn *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 64-70 refs (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00

Topographic and structural maps of small experimental craters are being prepared by photogrammetric techniques similar to those employed in conventional mapping projects. Vertical and horizontal scales are determined empirically by comparing measurements made on a stereo model with actual crater measurements; and a map is compiled at the scale of the stereo model, and the topography and structure are compiled separately on two registered pieces of scribe-coat base. Craters obtained from topographic maps with a compensating polar

planimeter have been compared with volumes obtained by filling the craters with Ottawa sand. While the average difference is 2%, some test measurements are the same and others differ by as much as 10%. M.W.R.

N66-35636# Naval Oceanographic Office, Washington, D. C. Oceanographic Prediction Div.
REPORT OF SEVERE ICE CONDITIONS IN MELVILLE BUGT, SUMMER 1964
G. Potocsky and F. Kniskern Mar. 1966 48 p *Its* Informal Manuscript Rept.-0-53-65
(AD-634531) CFSTI: HC $2.00/MF $0.50

Anomalous (severe) ice conditions occurred during summer 1964 in Melville Bugt. Factors producing the variation are analyzed in order to determine whether the anomaly should have been predicted. Based on historical conditions, however, the ice prediction had been made as accurately as possible, the variation was attributed to severe weather conditions. Author (TAB)

N66-35662*# Geological Survey, Flagstaff, Ariz.
INVESTIGATION OF IN SITU PHYSICAL PROPERTIES OF SURFACE AND SUBSURFACE SITE MATERIALS BY ENGINEERING GEOPHYSICAL TECHNIQUES Annual Report
Joel S. Watkins, Robert A. Loney, and Richard H. Godson (1964) 90 p refs
(NASA Order T-2509)
(NASA-CR-65488) CFSTI: HC $2.50/MF $1.75 CSCL 08G

Purpose of the studies was to investigate feasibility of surface and subsurface property determination by geophysical Four study sites were selected in the Flagstaff area of Arizona; techniques and to prepare for lunar geophysical experiments. their geological characteristics are discussed, and maps and photographs of the areas are presented. Tests were conducted to determine the attenuation rate of seismic energy. The obtained energy spectra were analyzed. Seismic instruments and field methods used in the tests are described. Preliminary data suggest that (1) non-explosive energy sources can be detected to distances up to 500 feet on the lunar surface with instrumentation comparable to that presently available, and (2) frequencies observed at short distances are higher than originally expected. K.W.

N66-35669# Royal Greenwich Observatory, Herstmonceux (England).
TIME AND LATITUDE SERVICE 1965, JULY - SEPTEMBER
London, HMSO, 1966 17 p refs *Its* Bull. No. 116 CFSTI: HC $1.00/MF $0.50

The Herstmonceux time and latitude observations, and the radio time signals are presented in tabular form. The Rugby and WWV coordinated emission times are also tabulated. N.E.N.

N66-35681# Academy of Sciences (USSR), Moscow.
INTENSIFIED OUTER ELECTRIC POLES ON THE SURFACES OF LARGE SOLIDS IN THE IONOSPHERE
L. L. Goryshnik and A. N. Dyukalov 1965 9 p refs In RUSSIAN Reprinted
CFSTI: HC $1.00/MF $0.50

The calculation of the intensification coefficient of weak electric fields on surfaces of large solids in the ionosphere is reviewed with reference to the works of earlier auth rs. Magnitude, quality, and characteristics of high-tension electric fields are discussed, and the arrangement of electrostatic fluxmeters in rockets is mentioned. Disregarding the photo-effect and secondary emission, the electric potential of solids in quasi-neutral and unperturbed plasmas is considered. Equations are given for the distribution function of ions and electrons and for determining the intensification coefficient. It is concluded that the intensification coefficient is proportionally related to the free-moving ions with Debye radius in unperturbed plasmas. Transl. by K.W.

N66-35683# Academy of Sciences (USSR), Moscow.
ELECTRONIC AND IONIC TEMPERATURES IN THE IONOSPHERE
T. K. Breus and G. L. Gdalevich Repr. From Kosmich. Issled. (Moscow), v. 3, no. 6, 1965 p 189–192 refs In RUSSIAN
CFSTI: HC $1.00/MF $0.50

Means and methods of obtaining temperature parameters of electrons and ions in the ionosphere are reviewed. Temperature characteristics of the ionosphere, and the interrelation of electrons and ions in the F layers, as established by rocket and satellite experiments are discussed. Mentioned are results obtained with the Explorer, Alouette, and Ariel satellites; with the Soviet Kosmos II; and also with U.S. and Japanese rocket probes, which yielded information on electron temperatures for altitudes up to 1200 km. Electron temperatures encountered by the satellites, and the temperature/altitude dependence as established by satellite rocket probes, are graphically shown. Described are experiments with rare gases for theoretical calculations of ion temperatures. The conclusions are that electron and ion temperatures increase with increasing altitude, and that the temperature of ions may exceed that of electrons considerably at altitudes greater than 1000 km. Transl. by K.W.

N66-35684# Academy of Sciences (USSR), Moscow.
RESULTS OF RESEARCH IN THE IONOSPHERE WITH THE AID OF ROCKETS AND SATELLITES IN 1960–1964
B. N. Gorozhankin and V. A. Rudakov 1965 15 p refs In RUSSIAN Reprinted CFSTI: HC $1.00/MF $0.50

Determination of electron and ion concentrations in the ionosphere is the main concern of this paper, and two measuring methods, namely soundings with reactions of sensitive elements and by means of radio waves, are briefly discussed. These two methods as used in rocket and satellite experiments are then reviewed. Tables are given with launch dates, altitudes, measured parameters, and country of origin. Additional tables give the results of electron density measurements at altitudes up to 2400 km. Included are U.S., U.S.S.R., British, and Japanese rocket probes. Satellite experiments are similarly discussed and then presented in tabulated form. The parameters measured here were electron and ion densities and temperatures. Results of the various experiments are discussed and compared in conclusion. Transl. by K.W.

N66-35698 India. Meteorological Dept., New Delhi.
MAGNETIC, METEOROLOGICAL AND ATMOSPHERIC ELECTRIC OBSERVATIONS MADE AT THE GOVERNMENT OBSERVATORIES, BOMBAY AND ALIBAG IN THE YEAR 1951 (1872-1873 SAKA). PART I: MAGNETIC OBSERVATIONS MADE AT ALIBAG
1964 72 p
CFSTI: HC $3.00/MF $0.75

Magnetic tables are presented on the following data: hourly variations of declination, horizontal force, and vertical force; diurnal variation of magnetic elements; Fourier analyses of the diurnal and annual variations of the horizontal and vertical forces; and magnetic characters and disturbances. N.E.N.

N66-35701# National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART II
Mar. 1966 15 p ref
(RRC-A129, Pt.-2I SG-2) CFSTI: HC $1.00/MF $0.50

Data recorded during February 1966 at Delhi are presented. The tables include predicted and observed sunspot numbers; solar flux, flares, and radio emission; and solar flare effects. N.E.N.

N66-35704# Academy of Sciences (USSR), Moscow.
A BRIEF SURVEY OF RESULTS OF PHYSICAL EXPERIMENTS IN CONDUCTION ON SATELLITE KOSMOS-2 IN THE IONOSPHERE

V. V. Afonin, T. K. Breus, G. D. Gdalevich, B. N. Gorozhankin, K. I. Gringauz et al 1965 23 p refs In RUSSIAN Presented at Moscow, 10–16 Jun. 1965 Reprinted
CFSTI: HC $1.00/MF $0.50

The study summarizes experiments and results carried out during investigation of the ionosphere in the latitudes from 49°N to 49°S and at altitudes between 212 to 1550 km by the Cosmos II satellite. Most instrumentation aboard the satellite was for ionospheric investigations or such related phenomena as electron photoemission, ultraviolet solar radiation, and effects on orbits of satellites. Concentration and distribution of positive ions in the satellite's orbit are discussed. A description of regional transition from predominantly light ions also contains equations for ion concentrations, ion collector tube voltage–amperage characteristics, and graphs of ion concentrations. Temperature and concentration measurements of electrons as taken by Langmuir probe and collector tube are analyzed and compared; the results are given in graphs and tables. Vector current and satellite orientation by means of an ion collector surface system are also discussed. It is concluded that the results, although valuable, cannot be considered final; they should be helpful in the preparation of new ionospheric experiments. Transl. by K.W

N66-35713# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
CIRCULATION OF THE MIDDLE AND UPPER ATMOSPHERE
Willis L. Webb 1966 22 p refs Presented at Cospar Intern. Space Sci. Symp. No. 7, Vienna, 16 May 1966
(AD-635523) CFSTI: HC $1.00/MF $0.50

Investigation of the stratospheric circulation through meteorological rocket network observations has revealed the presence of a complex circulation system in the upper atmosphere. Detail structure ranges in scale from the hemispheric-annual monsoonal reversal which is a dominant feature of the stratospheric circulation (25-80 KM) down to subkilometer-minutes variations characteristic of vertical profiles. A most important aspect of the stratospheric circulation is the strong diurnal temperature variation and resultant tidal circulation generated by the earth's rotation and ozone absorption of solar ultraviolet in a thin stratopause layer. This diurnal heat wave and tidal circulation has been shown to effectively stir the mesosphere and to provide special vertical motions such as those required to support noctilucent cloud particles and subsidence of the equatorial electrojet. Associated data has shown that the ionospheric and stratospheric circulation systems are not fully isolated, but are indeed interrelated, with a principal difference being a more active meridional global circulation in the ionospheric case. This difference is assumed to be due to an increasing importance with height of non-geostrophic influences on the circulation of the upper atmosphere. Author (TAB)

N66-35722# Travelers Research Center, Inc., Hartford, Conn.
PARTICLE FALLOUT AND DISPERSION IN THE ATMOSPHERE Quarterly Report No. 2, 1 Sep.–30 Nov. 1965
K. D. Hage and P. S. Brown Dec. 1965 51 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-66-2010) CFSTI: HC $3.00/MF $0.50

Progress is described on the development of an atmospheric fallout model to be used to estimate particulate concentrations in the air and on the earth's surface for particles released at any altitude up to 90 km. The particle size range of interest is 1 to 200 microns in diameter. The model is being programmed to be run on a CDC-3600 computer. Preliminary specifications and coding for the program were completed for all but one major component of the model. Author (NSA)

N66-35737*# Pittsburgh Univ., Pa. Space Research Coordination Center.
DETECTION OF HIGH ALTITUDE EXPLOSIONS BY OBSERVATION OF AIR FLUORESCENCE
T. M. Donahue 4 Nov. 1965 30 p
(Contract NASR-178)
(NASA-CR-68355; SRCC-19) CFSTI: HC $2.00/MF $0.50
CSCL 18C

Methods of detecting high altitude explosions based on observing the fluorescence radiation of the excited N_2 or N_2^+ from the ground and from satellites are discussed. The concept of using the air fluorescence pulse as a method of bomb detection is reviewed. Ground based systems utilizing N_2^+ blue fluorescence and broad band red systems are described in detail, and the characteristics of satellite based detectors are outlined. Discrimination against false alarms arising from lightning and twinkle in ground based fluorescence detector systems is considered. The suggestion of reducing the X-ray flux incident on earth from an explosion in space as well as the effective temperature as seen from earth by interposing a lead shield between the burst and the earth is also briefly covered. L.E.W.

N66-35751# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE STATISTICAL STRUCTURE OF THE WIND FIELD IN CENTRAL ASIA AND IN SOUTHERN KAZAKHSTAN
Z. G. Apsalyamova 29 Aug. 1966 14 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 6, 1966 p 36–40
(JPRS-37283; TT-66-33712) CFSTI: $1.00

Aerosynoptic conditions are considered for wind formations on the southern and southwestern peripheries of an anticyclone during clear, stable weather. The investigated area extends between 37.5° and 50°N, and 55° and 72.5°E. A regular grid of 48 points was selected, situated at the intersection of the meridians and parallels so that the distance between the two closest points was 250 km at 30° latitude. The greatest distance between the extreme points was 1,750 km. For each point in the field, the mean wind velocity was computed at 1500 and 2100 hours for the autumn–winter, and spring–summer seasons. Correlation coefficients were computed as functions of time and distance for latitudinal, longitudinal, and intermediate directions. A correlation diagram was constructed for the Nukus station; it is noted that the anisotropy of the pressure, temperature, and wind fields in the tropsphere is appreciable in many cases. Use of the computed data for prognostic purposes is also discussed. M.G.J.

N66-35784# Joint Publications Research Service, Washington, D. C.
AERIAL-PHOTOGRAPHIC, TOPOGRAPHIC-GEODETIC AND CARTOGRAPHIC WORK OF THE SOVIET UNION IN ANTARCTICA
B. V. Dubovskoy 26 Aug. 1966 19 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, 1966 p 51–61
(JPRS-37260; TT-66-33689) CFSTI: $1.00

Aerial photographic methods, developed to study Antarctica's natural phenomena, are discussed, and the cartographic work accomplished is described. Details on areas of photo coverage; main astro points; grounds lines with height determination by barometric and geodetic methods; and determination of ice cap surface elevations are given for the Queen Maud land, Enderby Land, the coast line between 45° to 78°E longitude; the Pravda shoreline; the coast line between 111° to 129°, and 142° to 166° E longitude; and the interior regions of Eastern Antarctica. The geographical and topographical Antarctica maps, which were compiled and published, are also discussed. These include the 1:3,000,00 scale map; and the 1:200,000, 1:100,000, 1:50,000, and 1:10,000 scale maps. M.G.J.

N66-35758# Joint Publications Research Service, Washington, D. C.

STEADY-STATE WIND CIRCULATION IN A HOMOGENEOUS OCEAN

A. I. Fel'zenbaum and N. B. Shapiro 22 Aug. 1966 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Mat., Fiz. (Moscow), v. 168, no. 1–3, 1966 p 569–572
(JPRS-37153; TT-66-33582) CFSTI: $1.00

A numerical solution is presented for the problem of steady state circulation excited in a rectangular ocean of constant depth by a system of zonal winds. Relaxation, splitting, and adjustment methods are used, and a parabolic-type equation is formulated. M.G.J.

N66-35767# Joint Publications Research Service, Washington, D. C.

STUDY OF IONOSPHERIC LAYERS IN THE INFRARED SPECTRAL REGION

M. N. Markov, Ya. I. Merson, and M. R. Shamilev 16 Aug. 1966 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz., Mat. (Moscow), v. 167, no. 4–6, 1966 p 803–806
(JPRS-37029; TT-66-33459) CFSTI: $1.00

Data obtained from geophysical balloon and rocket measurements taken at heights from 25 to 500 km are summarized, and estimates are presented on the possibility of correlating this data with other information on the atmosphere. An atmospheric model is considered which does not include absorbing gases between the radiating layers; the point is made that altitudinal and angular radiation distribution cannot be reconciled with one another except on the assumption that the radiation is localized in definite layers (5 to 10 km), situated at some heights close to the upper and lower boundaries of the F-2 layer. It is also assumed that the radiating layer thicknesses at 280, 420, and 500 km is 5 km, and the effective angle of sight of the instrument is about 0.5°. The relative intensity curve is computed and constructed for the angular radiation distribution curves; the intensity is considered to be proprotional to the length of the radiating layer, and the radiation dilution is taken into account. Findings show a correlation between the infrared radiation of the ionosphere and flares near the central meridian of the solar disk. M.G.J.

N66-35769# Joint Publications Research Service, Washington, D. C.

SETTLING RATE OF ATMOSPHERIC PARTICLES

A. P. Manzhula and S. A. Kolonitskiy 1 Sep. 1966 9 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atmosfery i Okeana (Moscow), v. 1, no. 9, Sep. 1966 p 994–995
(JPRS-37390; TT-66-33819) CFSTI: $1.00

A universal equation is given for computing the rate of fall of spherical particles in the atmosphere, along with an interpolation equation in which the particle fall velocity is determined from the Stokes formula. Based on these formulas, an equation is obtained for calculating the rate of fall in the atmosphere of particles with a given radius and density. It is pointed out that the particle fall velocity varies with altitude, since the air viscosity and density vary. Therefore, values of atmospheric density and viscosity, averaged with respect to altitude, are substituted. Tabulated date are included to show the average particle setting velocity based on the particle radius, and the altitude from which the particles fall. M.G.J.

N66-35781# Joint Publications Research Service, Washington, D. C.

LUNAR-SOLAR SEMI-MONTHLY AND MONTHLY TIDES IN THE SEAS OF THE SOVIET ARCTIC

V. N. Vorob'yev 16 Aug. 1966 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz., Mat. (Moscow), v. 167, no. 4–6, 1966 p 1039–1041
(JPRS-37031; TT-66-33461) CFSTI: $1.00

In studying semimonthly and monthly tidal waves, more than 100 annual cycles of level observations, made at 22 Soviet Arctic stations, were used. A harmonic method was employed in the analysis, and the harmonic constants of the lunar semimonthly wave (M_f), and the lunar monthly wave (M_m) are tabulated. These data indicate that the semimonthly and montly tides can change the mean level of the sea by 6 to 8 cm even on days when the wave phases do not coincide; on days characterized by a coincidence of these wave phases, the fluctuations on the average can attain 12 to 15 cm. In considering how the semimonthly and monthly tides are manifested in the individual seas, the mean amplitudes of the wave and the mean values of the phase shift for each sea are computed. As the data show that the maximum amplitudes of the long-period M_f and M_m waves are observed in the Chukchee Sea, the conclusion is drawn that there is an antinode of the semimonthly and monthly tidal waves in the Arctic Ocean. M.G.J.

N66-35780*# Consultants and Designers, Inc., Arlington, Va.

DETERMINATION OF BOUNDARIES OF CLOUDINESS [OB OPREDELENII GRANITS OBLACHNOSTI]

I. A. Kibel' 27 Aug. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), v. 160, no. 4, 1965 p 815–818
(Contract NSA5-3760)
(NASA-CR-77704; ST-AM-10376) CFSTI: HC $1.00/MF $0.50 CSCL 04B

The determination of boundaries of cloudiness, as described here, is based upon considering an adiabatic flow, in which are disseminated separate regions with pseudoadiabatic processes, whose boundaries are not known in advance and must be determined alongside with the solution of the problem of motion itself. On that basis, conditions are derived outside and inside the cloud, and a particular example is considered. Author

N66-35788*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE SHAPE AND LOCATION OF THE DIURNAL BULGE IN THE UPPER ATMOSPHERE

L. G. Jacchia and J. Slowey 1 Apr. 1966 24 p refs
(Contract NsG 87-60)
(NASA-CR-77652; SAO Special Rept.-207) CFSTI: HC $1.00/MF $0.50 CSCL 04A

An analysis of the drag of the two balloon satellites in near-polar orbits launched in the course of the last 2 years (Explorers 19 and 24) has afforded the opportunity of our studying the distribution of density and temperature at high latitudes, and has led to strange results concerning the shape and behavior of the diurnal atmospheric bulge. The picture of a bulge in which temperature and density decrease nearly symmetrically in all directions from a location that follows the latitude migrations of the subsolar point would seem to need considerable revision, at least for heights above 500 km. It appears that the bulge is noticeably elongated in the north-south direction and that its center does not move much from the equator—a picture that is reminiscent of that of the ion density distributions in the F_2 layer. Some possible implications are discussed, as well as sources of error that may have affected these results. Author

N66-35801*# Consultants and Designers, Inc., Arlington, Va.

ON THE TOTAL AMOUNT OF NEUTRAL HYDROGEN IN THE UPPER ATMOSPHERE OF THE EARTH [O POLNOM KOLICHESTVE NEYTRAL'NOGO VODORODA V VERKHNEY ATMOSFERE ZEMLI]

V. G. Kurt 5 Apr. 1966 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, issue 1 1966 p 111–115
(Contract NAS5-9299)
(NASA-CR-77676; ST-AI-OA-10470) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The albedo dependence (ratio of scattered radiation intensity in the zenith and nadir) on altitude for various values of aggregate optical thickness is plotted on the basis of the approximate transfer theory of L_α-emission in the Earth's atmosphere, taking into account the degree of shadiness. It is found that the best agreement of theory with experiment is obtained with the aggregate optical thickness $\tau_0=7$ for the dipping angle of the Sun under horizon equal to 40°, and at $\tau_0=12$ for 75°. Author

N66-35831# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
A STUDY OF ENERGY SOURCES FOR THE THERMOSPHERE
James R. Mahoney (Ph. D. Thesis) 15 Jan. 1966 232 p refs
(Contract AT(30-1)-2241))
(MIT-2241-16) CFSTI: HC $6.00/MF $1.25

The importance of various sources and sinks of energy for the thermosphere is investigated in two separate but related studies. In one study a time-dependent model of solar heating, radiational cooling and conductive redistribution of energy from 80 to approximately 500 kilometers is used to investigate the relationships between various specifications of heating rates and resulting changes in thermospheric structure. It is found that the model is highly sensitive to changes in the various heating parameters (solar flux intensity, absorption cross-sections, coefficients of heat conduction and radiative cooling rates), and that the model results agree with the data for the thermosphere only for relatively limited ranges of these parameters. A parallel study of photoionization rates indicates that diurnal changes in neutral atmospheric structure are of primary importance in determining the spatial and temporal profiles of ion production. In the other study several detailed soundings of mesospheric winds (from 30 to 70 kilometers approximately) were used to estimate the magnitude of the vertical energy flux into the lower thermosphere which can be accomplished by small scale traveling wave motions. The analysis is hindered by the smoothing which was applied to the original wind data, but it is likely that the 80 to 105 kilometer region receives more energy by the dissipation of vertically propagating motions than by solar heating and conduction heating from above. Author (NSA)

N66-35939*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR PHASE NUMBERS *p* AND *p'* FOR YEARS 1850 TO 2050
Masahisa Sugiura and G. Fanselau (Geomagnetisches Inst., Potsdam, East Germany)
Jun. 1966 236 p refs Prepared in part for IAGA-IAMAP Joint Comm. on Lunar Effects
(NASA-TM-X-55557; X-612-66-401) CFSTI: HC $3.75/MF $1.50 CSCL 08N

For analyses of lunar effects on geophysical phenomena the phase of the mean moon is more useful than that of the apparent moon. Tables of the lunar phase number *p* and those of integral phase number *p'* introduced by Bartels are given for Greenwich mean noon on each day of the year 1900 to 2050. A list of dates of new moon over this period is also given. Author

N66-35943*# Hayes International Corp., Birmingham, Ala.
SOIL EROSION BY LANDING ROCKETS Final Report
J. D. Alexander, W. M. Roberds, and R. F. Scott 15 Jul. 1966 99 p refs *Its* Eng. Rept.-1301
(Contract NAS9-4825)
(NASA-CR-65484) CFSTI: HC $2.50/MF $0.75 CSCL 08M

A test program involving a series of pressurized cold gas (nitrogen) firings and a series of live rocket firings has been conducted to evaluate the cratering which would be expected from a reentry capsule using retro rockets to assist in a soft earth landing. These firings involved both stationary jets and jets moving with horizontal velocities as high as 30 ft/sec. over sand, scalped earth, and sod soils. It was found that for jet surface pressures above a critical value, cratering resulted from an explosive failure of the material as the yield strength of the soil below the surface was exceeded. For lower surface pressures cratering results from a relatively gradual erosion action. A somewhat detailed theoretical model has been developed to explain the explosive cratering resulting from a single rocket at normal incidence in the soil surface. Also, a simplified method has been developed which will permit engineering estimates of crater dimensions to be made over a variety of jet–soil conditions. The jet and soil properties which are significant in crater formation have been defined in a manner suitable for engineering applications over a wide range of terrestrial conditions. Author

N66-35968*# Geological Survey, Flagstaff, Ariz.
INVESTIGATION OF IN SITU PHYSICAL PROPERTIES OF SURFACE AND SUBSURFACE SITE MATERIALS BY ENGINEERING GEOPHYSICAL TECHNIQUES Annual Report, Fiscal Year 1965
Joel S. Watkins, Jean Cl. De Bremaecker, Robert A. Loney, James H. Whitcomb, and Richard H. Godson 1965 185 p refs
(NASA Order T-25091(G))
(NASA-CR-65489) CFSTI: HC $3.25/MF $1.25 CSCL 08G

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2. SEISMIC INVESTIGATION OF NEAR-SURFACE CAVITIES—A PRELIMINARY REPORT J. S. Watkins, R. H. Godson, and K. Watson 27 p ref (See N66-35968 21-13)
3. SHEAR-WAVE DETECTION J. H. Whitcomb 11 p (See N66-35969 21-13)
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6. VELOCITIES AND ATTENUATIONS OF HEAD-WAVE AMPLITUDES OBSERVED IN LUNAR ANALOG ROCKS R. H. Godson, J. S. Watkins, and R. A. Loney 26 p (See N66-35972 2 21-13)

N66-35968*# Geological Survey, Flagstaff, Ariz.
SEISMIC INVESTIGATION OF NEAR-SURFACE CAVITIES—A PRELIMINARY REPORT
Joel S. Watkins, Richard H. Godson, and Kenneth Watson *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. 1965 27 p ref (See N66-35966 21-13) CFSTI: HC $3.25/MF $1.25

Two lava tunnels located a few feet below the surface of the ground and a cavity formed as a result of an underground nuclear explosion and subsequent collapse of the overlying rock were delineated at the Nevada Test Site. The top of the cavity at the Test Site was 25 m below the surface. Three

seismic phenomena—vibrations of the cavity walls, anomalous amplitude attenuations, and delays in arrival times—have been observed in the vicinity of the cavities. Of these three phenomena, wall vibrations are the most diagnostic for location and delineation of cavities. Anomalous attenuations of amplitudes and delays in arrival times can be caused by local geological conditions other than cavities, but provide important supplemental evidence. Author

N66-35969*# Geological Survey, Flagstaff, Ariz.
SHEAR-WAVE DETECTION
James H. Whitcomb *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. 1965 11 p (See N66-35966 21-13) CFSTI: HC $3.25/MF $1.25

Shallow (less than 20m) seismic refraction investigations of *in situ* materials showed that the SH-wave is usually immersed in a high noise level, presumably of P-wave nature, when recorded by 3-component geophones. Angular transducers record SH-waves while excluding all energy of a P-wave nature because the curl of the displacement of the P-wave is zero and that of the S-wave is not. Results of field tests of two angular accelerometers showed that angular transducers enable better SH-wave detection than 3-component transducers. Author

N66-35970*# Geological Survey, Flagstaff, Ariz.
THE KANA-A FLOW, AN ALKALI BASALT OF THE SAN FRANCISCO VOLCANIC FIELD, ARIZONA
Robert A. Loney *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. 1965 49 p refs (See N66-35966 21-13) CFSTI: HC $3.25/MF $1.25

The Kana-a basalt flow northeast of the base of Sunset Crater, a cinder cone in the San Francisco volcanic field near Flagstaff, Arizona, is mantled by a thin ash deposit that erupted from the top of the cone contemporaneously with the extrusion of the flow. Core holes drilled in the southeastern part of the flow show this part to be 10.5 m thick and to consist of the following structural units: (1) oxidized, scoriaceous to highly vesicular unit, 1.5 to 2.4 m thick; (2) moderately vesicular unit, 2.7 to 3.4 m thick; (3) massive, sparsely vesicular unit, 3.1 to 4.0 m thick; and (4) highly vesicular, slightly oxidized unit, which averages about 1.0 m thick. Two types of basalt were distinguished: a slightly glassy, oxidized basalt forming the crust, and a normal, holocrystalline basalt that forms the bulk of the flow. Both consist largely of andesine-labradorite, diopsidic augite, olivine ($Fo_{78}Fa_{22}$), and magnetite. This mineral assemblage, together with three new chemical analyses, indicates an alkali olivine basalt. Author

N66-35971*# Geological Survey, Flagstaff, Ariz.
ATTENUATION MEASUREMENTS IN THE FIELD
Jean Cl. De Bremaecker, Richard H. Godson, and Joel S. Watkins (Rice Univ.) *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. 1965 25 p refs (See N66-35966 21-13) CFSTI: HC $3.25/MF $1.25

The amplitudes of the P head wave were measured on an a lava flow, on unconsolidated cinders, and on compact limestone. The data are satisfied by the equation $A = N d^{-2} \exp(-\pi d Q^{-1}{}_{\alpha} \nu \alpha^{-1})$, where A is the amplitude, d the distance, Q_α the attenuation coefficient for P waves, ν the frequency and α the P wave velocity. This equation results from the assumption of a complex shear modulus μ^* but a real λ, which also yields $Q_\alpha/Q_\beta = 0.5\ \alpha^2/\beta^2$. ($\beta$=shear wave velocity.) This formula is in reasonable agreement with published data. Author

N66-35972*# Geological Survey, Flagstaff, Ariz.
VELOCITIES AND ATTENUATIONS OF HEAD-WAVE AMPLITUDES OBSERVED IN LUNAR ANALOG ROCKS
Richard H. Godson, Joel S. Watkins, and Robert A. Loney *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. 1965 26 p (See N66-35966 21-13) CFSTI: HC $3.25/MF $1.25

Seismic data collected at 11 sites, each having structural and lithologic similarities with those inferred for lunar near-surface materials, indicate that P head wave amplitude attenuation is strongly affected by fracturing. Velocity seems dependent on porosity and degree of cementation. The data have formed the basis for an estimate of amplitude attenuations on the lunar surface and were incorporated into the design of a proposed lunar engineering seismic experiment. Author

N66-35988# Joint Publications Research Service, Washington, D. C.
THE NATURE OF GRAVITY ANOMALIES OF SOUTHWESTERN SAKHALIN
P. M. Sychev 16 Aug. 1966 16 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), No. 2, 1965 p 92–98 refs
(JPRS-37040; TT-66-33470) CFSTI: $1.00

This paper gives a geological interpretation of the Lopatinskiy gravitational maximum, situated in southwestern Sakhalin and corresponding to the anticlinal fold of the same name in tertiary deposits. An evaluation is made of the tertiary and cretaceous deposits along a latitudinal profile. It is postulated that the patterns found in this region are applicable to the entire intensive positive gravity anomaly picture of the southwestern part of the island. Author

N66-35990# Joint Publications Research Service, Washington, D. C.
THE ACCURACY OF GEODETIC MEASUREMENTS IN GEOLOGICAL SURVEY OPERATIONS—PRO AND CON
1 Sep. 1966 34 p refs Transl. into ENGLISH from Geodez. Kartograf. (Moscow), No. 11, Nov. 1965 p 29–38 refs
(JPRS-37374; TT-66-33803) CFSTI: $2.00

The accuracy of geodetic measurements in seismic surveying was analyzed by compiling the limiting relative errors from the following assumptions (1) that the apparent propagation velocity of seismic waves was equal to the propagation velocity of a direct wave; (2) that the apparent velocity was not erroneous; and (3) that only time was accepted as the measured quantity. Calculations using the principle of equal influences established the limiting measurement error of angles in an azimuthal installation as not more than 2°. The limiting error of angle drift on a full scale equatorial installation should not be more than 3° G.G.

N66-35991# Bureau of Mines, Minneapolis, Minn.
ANALYSIS OF STRESSES IN A ROCK DISK SUBJECTED TO PERIPHERAL THERMAL SHOCK
T. S. Chen and R. L. Marovelli 1966 59 p refs
(BM-RI-6323)

A study was made of the temperature and thermal stress distributions in thin circular disks subjected to peripheral thermal shock at various rates of heat transfer. The theoretical analysis is based on one-dimensional radial heat flow by conduction in the disk, and on heat exchange by convection between the disk and its surroundings. Preliminary experimental data obtained from shock tests on thin circular disks of basalt, quartzite, and taconite show reasonably good agreement with theory. The case of constant properties and plane

stress is treated. Solutions of the stress distribution are presented for both cooling and heating shocks. The elastic energy stored at fracture is examined, and on this basis an average stress theory is formulated. Physical properties vital to the studies include thermal conductivity, thermal diffusivity, tensile strength, Young's modulus, and linear coefficient of thermal expansion. This work is of importance in predicting the thermal shock responses of a rock body of finite size. Author

N66-36001# National Severe Storms Lab., Norman, Okla.
MEASUREMENTS BY AIRCRAFT OF CONDENSED WATER IN GREAT PLAINS THUNDERSTORMS
George P. Roys (ASD, Wright-Patterson AFB, Ohio) and Edwin Kessler Jul. 1966 24 p refs
(TN-49-NSSP-19)

An aircraft equipped to measure condensed water has obtained records in Oklahoma thunderstorms during 22 traverses above 25,000 feet. The average measured value of the maximum water content in the penetrated storms is 8.4 gm./m.^{3}; this includes the exceptional value 44 gm./m.^{3} recorded once. The extreme observation is discussed in the light of comments by the aircraft crew, radar observations, and simple theory. While the validity of the extreme observation is not clearly established, theoretical and empirical bases are presented for the logical conception of such high water contents. It seems important to make additional measurements of storm water contents with numerous complementary observations. Author

N66-36015# AVCO Corp., Wilmington, Mass. Research and Development Div.
ANTARCTIC RESEARCH AND DATA ANALYSIS. AN INVESTIGATION OF SUMMER EVENING INCREASES OF F LAYER ELECTRON DENSITY IN THE REGION OF THE ANTARCTIC PENINSULA Scientific Report No. 22
Gerald F. Rourke 29 Mar. 1966 56 p refs
(Contract NSF C403)
(RAD-TR-66-11; PB-169667) CFSTI: HC $5.60/MF $0.50

The summer evening increase of f_0F_2 in the area of the Antarctic Peninsula has been investigated. It has been concluded that the behavior of f_0F_2 is related to similar variations in the Northern Hemisphere. Increases observed in the evening hours of the F layer peak electron density also occur up to an altitude of at least 1000 km. The behavior of f_0F_2 indicates that the evening rise in electron density is presented throughout the summer and the solar cycle. At the time of the increase in electron density there is a decrease in the local scale height which we interpret as primarily due to a decrease in the electron–ion temperature of at least 600°K. The difference between geographic and geomagnetic coordinates points up certain preferred longitudes and latitudes where one could expect an evening increase in electron density. Evidence presented herein supports the conclusion that the Antarctic Peninsula summer evening increase of f_0F_2 is but one element in a world wide F layer system that is dependent on ionosphere-protonosphere coupling for its maintenance. Author

N66-36030# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
STUDIES ON GEODETIC GRAVIMETRY [ISSLEDOVANIYA PO GEODEZICHESKOY GRAVIMETRII]
V. V. Brovar ed., 1965 208 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issledovatel. Inst. Geodezii, Aero' yemki i Kartografii (Moscow), Issue 157, 1965 p 1–204
(TC-971; TT-66-62643; AD-634934) CFSTI: HC $6.00/MF $1.25

Contents: Methods of calculation based on Molodenskiy's integral equation for the disturbing potential; verification on a model of the principle of numerical integration for the computation of the disturbing potential, based on Molodenskiy's integral equation; evaluation on a model of the earth of the individual terms of the correction to Stoke's approximation of the coefficients of expansion of the disturbing potential; evaluation of the mean value of the square of inclinations in the individual sections of a mountain area; on the calculation of normal heights; use of first-approximation formulas for the computation of the characteristics of the earth's gravitational field; tables for the computation of the nonlinearity of the influence of the heights of the topographic massif on plumb line deflections; template used for the computation of the influence of adjacent zones upon the height of the quasi-geoid and the deflection of the plumb line during the evaluation of the influence of the given zones by Molodenskiy's formulas; computation of first and second vertical derivatives of gravity from maps of its anomalies; evaluation with the aid of terrestrial models of the precision of Numerov's formula for the vertical gradient of gravity; comments on the short report of I. F. Monin on the computation of deflections of the plumb line. TAB

N66-36031# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ON THE QUESTION OF DETERMINING NORMAL HEIGHTS [K VOPROSU OB OPREDELENII NORMAL'NYKH VYSOT]
V. F. Yeremeyev [1966] 27 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issledovatel. Inst. Geodezii, Aeros'-yemki i Kartografii (Moscow), Issue 157, 1965 p 69–84 refs
(ACIC-TC-1046; TT-66-61651; AD-634927) CFSTI: HC $2.00/MF $0.50

Formulas for calculating normal heights, normal heights differences and theoretical closing-errors of spirit-levelling polygons have been obtained, which formulas may ensure an accuracy of the order of a millimeter in mountainous regions. Methods are proposed for computing the heights of points located in the interior of the earth. It is shown that the Vignal's system of heights was obtained irrespectively of the problem of determining the total height of points on the physical surface of the earth above the reference ellipsoid. Vignal's heights system is not identical with the system of normal heights. In spite of the widely-spread opinion, the method of height determination proposed by Rune is not identical with that of normal heights determination. The results of computations according to Rune's formulas depend on the path of the levelling line. Some inaccuracies in articles by Bokun and Chojnicki are mentioned. Author (TAB)

N66-36033# Utah Univ., Salt Lake City. Dept. of Meteorology.
MICRO-METEOROLOGICAL RADIATION PROBLEMS
Dell Vaughn Mc Donald (M.S. Thesis) Jun. 1966 39 p refs
(AD-635237) CFSTI: HC $4.00/MF $0.50

This investigation concerns itself with two micrometeorological infrared radiation problems. (1) The first problem deals with the determination of long wave radiation along the line of symmetry inside and above a cone. Such a cone, embedded in the plane earth, is thought to idealize a valley. The radiative transfer equations were set up in such a manner as to deal with the special geometry involved. (2) The diurnal distribution of infrared water vapor cooling rates for a plane parallel and homogeneous atmosphere near the ground is investigated. In order to have continuous temperature distributions as a function of time, observed temperature gradients were subjected to harmonic analysis. Author (TAB)

N66-36046*# Physics International Co., San Leandro, Calif.
STUDY OF TWO-DIMENSIONAL CALCULATION OF CRATERING

Donald E. Maxwell, Ronald Hofmann, Dudley J. Andrews, and Ernest T. Trigg 30 Jun. 1966 90 p refs
(Contract NAS5-9202)
(NASA-CR-77768; PIFR-032) CFSTI: HC $3.00/MF $0.75 CSCL 20K

A two-dimensional, time-dependent, coupled Eulerian-Lagrangian code (ELK) designed specifically for cratering calculations was used to solve three example cratering problems. The first problem involves simulation of the Danny Boy nuclear cratering experiment, and is an example of an explosive type of cratering problem. The second problem involves an aluminum sphere impacting an aluminum half space (impact type problem); and the third problem deals with another type of impact situation in which the trajectories of ejecta emmitted from a large comet impacting the surface of the earth are calculated. Features of the code itself, and of the granular media are described. In addition, equations for bulk and shear moduli from isotropic assumptions; and equations for a loading curve for a loose basalt compacting model are derived. L.S.

N66-36067*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
GEOMETRIC STRUCTURE OF THE EARTH'S GRAVITATIONAL FIELD AS DERIVED FROM ARTIFICIAL SATELLITES
W. Koehnlein 28 Jan. 1966 116 p refs
(Grant NsG-87-60)
(NASA-CR-77653; SAO Special Rept.-198) CFSTI: HC $4.00/MF $1.00 CSCL 08N

The structure of the Earth's gravitational potential and its gradient is studied at sea level and in outer space (1,000 km, 10,000 km, and 100,000 km elevation above sea level), with particular consideration given to the surfaces of constant potential and of constant gravitation. Their shape, curvature, etc., are computed and the results presented in tables and maps using the zonal part of the gravitational field as a reference frame. In a concluding section the geometry of the orthogonal trajectories of the equipotential surfaces is briefly touched. Among others, the curvature and torsion of the verticals are derived and the trajectories are integrated up to 10 km height for the gravity field and 100,000 km for the gravitational field. All numerical computations are based on Izak's and Kozai's latest harmonic coefficients of the gravitational potential. Author

N66-36068*# Graduate Research Center of the Southwest, Dallas, Tex.
INVESTIGATIONS INTO THE MECHANISM AND RATES OF ATMOSPHERIC MIXING IN THE LOWER THERMOSPHERE Semiannual Status Report
15 Sep. 1966 7 p refs
(Grant NGR-44-004-026)
(NASA-CR-77859) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The effects are discussed of eddy mixing in the lower thermosphere on atmospheric composition for a number of different rates of eddy mixing, characterized by coefficients in the range from 2 to 8 × 10^6 cm^2 sec^{-1}. It is reported that calculations, without taking into account vertical current effects, have given smaller argon concentrations than anticipated by a factor as high as ten. The atomic-to-molecular-oxygen ratio was low, indicating a higher than normal mixing rate, and a relatively high helium concentration was also observed. The influence of internal gravity waves on eddy mixing is also mentioned, and it is suggested that gravity waves may be a source of atmospheric turbulence. A.G.O

N66-36069*# Colorado State Univ., Fort Collins.
HEAT TRANSFER FROM LARGE DIAMETER PIRANI GAUGES OPERATING DOWN TO MICROTORR
John E. Braly (M.S. Thesis) Mar. 1966 53 p refs
(Grant NsG-570)
(NASA-CR-77857) CFSTI: HC $3.00/MF $0.50 CSCL 20M

Heat transfer from a cylinder in a symmetrical chamber was investigated for dependence on pressure, size and temperature of the cylinder, and molecular weight of the gas. Thin films on large diameter cylindrical substrates were used as the heating and sensing element. The theory of heat transfer from coaxial cylinders was discussed, and experimental operations such as cylinder preparation, vacuum testing, and pressure and temperature-resistance measurements were described. Experimental results showed that the large diameter enchanced the molecular conductivity and the sensitive pressure range. It was noted that the temperature of the cylinder is dependent on the pressure, and as the pressure decreases from atmospheric, large temperature changes were seen due to convection. Although the temperature of the cylinder is almost constant in the 10^{-4} to 10^{-6} torr range, the potential difference, and hence readability, is still increasing with decreasing pressure in this range. Thus, the useful range of such a gauge has been extended two orders of magnitude. The report also includes derivations of a conduction equation and the possibility for extending even further the gauge useful range. A.G.O.

N66-36104# Joint Publications Research Service, Washington, D. C.
IMMUNITY OF AMPLITUDE CRITERIA OF SEISMIC WAVE PHASE CORRELATION
S. V. Gol'din 30 Aug. 1966 23 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), No. 4, 1966 p 107-119
(JPRS-37353; TT-66-33782) CFSTI: $1.00

This paper considers the immunity of a number of formalized criteria for the detection and identification of seismic waves, based on measurement of the parameters of the extrema of the observed record. Author

N66-36238# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
EXPERIMENTAL WORKS WITH A PENDULUM INSTRUMENT ABOARD THE SURFACE SHIP [OPYTNYYE RABOTY NA NADVODNOM KORABLE S MAYATNIKOVYM PRIBOROM]
B. M. Malakhov [1966] 53 p refs Transl. into ENGLISH from Tr. Tsentral. Nauchn.-Issledovatel Inst. Geodezii, Aeros'yemki i Kartografii (Moscow), Issue 159, 1964 p 29-59
(ACIC-TC-985; TT-66-61223; AD-632485) CFSTI: HC $3.00/MF $0.50

The report discusses gravity measurements that could be carried out at sea by means of pendulums. TAB

N66-36269# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
WELL-LOGGING METHODS BASED ON THE USE OF ISOTAPE SOURCES OF NUCLEAR RADIATION
L. Jurkiewicz (Inst. of Nucl. Res., Cracow, Poland) and J. A. Czubek (Inst. of Nucl. Tech., Cracow) Feb. 1966 48 p refs Presented at the IAEA Panel on Uses of Radioisotopes in the Evaluation, Develop., Exploit. and Process. of Nat. Resources (Excluding Water), Cracow, Poland, 25-29 Oct. 1965
(INR-692/VI/PL) CFSTI: HC $2.00/MF $0.50

This survey contains methods routinely applied in geophysical prospecting as well as those being still investigated. The outlines of natural gamma-ray logging, gamma-gamma

logging, neutron logging methods and photoneutron logging are described with regard to applicability and theoretical analysis. The chapter on natural gamma ray logging shows some disadvantages in the spectral composition of registered gamma-rays. Results of gamma-gamma logging investigations deal with the measurements of rock bulk densities and some modifications that have to be applied in prospecting for heavy elements in boreholes. Ten different methods are listed in connection with neutron logging, and the advantages and disadvantages of theories and experiments related to these methods are pointed out. Photoneutron logging evolved as the method most useful in beryllium prospecting. Borehole apparatus detection problems and the difficulties of its proper calibration are also discussed. Author

N66-36404*# RAND Corp., Santa Monica, Calif.
ESTIMATED SURFACE MOTIONS OF THE EARTH'S CORE
Anne B. Kahle, E. H. Vestine, and R. H. Ball Aug. 1966 32 p refs
(Contract NASr-21(05))
(NASA-CR-77935; RM-5091-NASA) CFSTI: HC $2.00/MF $0.50 CSCL 08N

Previous work on theoretically inferred surface fluid motions of the earth's core is extended for epoch 1955, using secular change for the period 1912 to 1955. The surface flow is estimated using the frozen-field concepts of Alfvén, including the effect on the secular change resulting from the nonuniformity in the flow pattern. It is also assumed that both dipole and non-dipole terms of the main field are carried by the fluid. The flow is estimated by assuming that the horizontal surface flow can be resolved into two components, rotational and irrotational. The rotational component is composed of the westward drift and flow around closed streamlines on the surface of the core. The irrotational component is flow from sources to sinks and gives some information about the vertical flow. The westward drift does not appear to dominate the flow. In addition a strong upflow is found in the Southern Hemisphere, centered south of Africa, with a corresponding downflow in the Northern Hemisphere centered in the Mediterranean. There are also strong rotational velocities, particularly in the region of Africa. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-35380# Naval Research Lab., Washington, D. C.
LIQUID NITROGEN COOLED TELESCOPE FOR ROCKET INFRARED ASTRONOMY
D. P. Mc Nutt, M. Herwit, (Cornell Univ.), K. Shivanandan, B. J. Zajac (Maryland Univ.), and P. P. Feldman *In its* Rept. of NRL Progress Jun. 1966 p 1–6 refs (See N66-35359 21-34) CFSTI: $1.25

Observations of celestial infrared radiation from the ground or from balloons are seriously hampered by the earth's atmosphere. An infrared telescope has been designed, fabricated, and flown in an Aerobee-Hi rocket with limited success. The telescope measured absolute infrared signal strength from astronomical objects in the wavelength range out to about 7.5 microns. The telescope was designed to provide a wide field of view and fast optics. To eliminate radiation from the instruments it was cooled to liquid nitrogen temperature and equipped with the following components: aluminized fused silica mirrors in a Cassegrain configuration, silicon and germanium filters to block radiation of wavelength less than 1 micron and 3 microns respectively, three sets of baffles to suppress stray irradiation, and a motor-driven chopper. After the Aerobee rocket was launched, 24 complete scans of the sky were obtained in the 286 seconds that the detectors operated. Author

N66-35418# Regional Engineering College, Durgapur (India). Dept. of Physics.
CHARACTERISTICS OF A DOUBLE MAGNET COSMIC RAY SPECTROGRAPH TO BE BUILT AT DURGAPUR
B. C. Nandy and M. S. Sinha *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 359–367 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Characteristics and design features are discussed for a double magnet cosmic ray spectrograph to be built at Durgapur for studying the momentum-specific ionization relation of muons and their charge ratios in the range of momentum 12 Gev/c to 1286 Gev/c. Muons will trigger a three-fold coincidence of scintillation counters, and momentum would be determined from combined angular deflection in two large solid iron magnets with a scattering error of 17%. For studying variations of magnetic induction, an experiment on a steel plate model magnet was performed; and variation was found to be below ±1% with the saturation field of 14 kilogauss. Author

N66-35450# Tata Inst. of Fundamental Research, Bombay (India).
A LARGE RADIO TELESCOPE FOR OBSERVATIONS OF THE RADIO GALAXIES USING THE METHOD OF LUNAR OCCULTATION
G. Swarup *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 745–750 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A large radio telescope is being constructed which has been specially designed for lunar occultation observations of very distant radio galaxies. The instrument consists of a 500 long and 30 wide parabolic cylinder which will be placed on a hill slope having the same inclination to the horizontal as the latitude of the station (about 11°). This configuration will permit tracking of radio sources for roughly 8 hr a day by a simple motion of the antenna around its mechanical axis. The beam of the antenna will be changed in declination by ±35° by introducing time delays between adjacent dipoles of the long array which will be placed along the focal line of the parabolic cylinder. The instrument will be used mainly for identifications of radio sources and for cosmological investigations by studying number/intensity and number/diameter relationships. It is expected to observe more than 100 occultations per year. Other programs such as flare star observations will also be undertaken. Author

N66-35460# Naval Air Test Center, Patuxent River, Md. NANEP Branch.
TECHNICAL INVESTIGATION OF SWEEP CALIBRATION TECHNIQUES Interim Report
W. Simon 16 Jun. 1966 34 p
(AD-635286) CFSTI: HC $2.00/MF $0.50

Several methods for rapid calibration of coaxial devices were investigated. Stress was placed upon the applicability of each method to out-of-band frequency ranges, i.e., those

frequencies outside the limits in which the manufacturer guarantees performance. This report contains the results of phase I of the investigation: a survey of present techniques. Phase II will consist of applying the appropriate techniques in calibrating the coaxial devices utilized by the NANEP spectrum signature field team. Author (TAB)

N66-35553*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LOCAL MEASUREMENTS IN TURBULENT FLOWS THROUGH CROSS CORRELATION OF OPTICAL SIGNALS

M. J. Fisher (IIT Res. Inst.) and F. R. Fisher *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 66–76 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

The cross correlation of optical signals was developed to provide the necessary inputs for statistical analysis of responses like rigid body motions, unsteady forces, elastic deformations, as well as heat, mass, and momentum fluxes. The method estimates local power spectra, turbulence scales, convection velocities, and eddy lifetimes with the data reduction procedures developed for conventional two-point measurements with standard probes. An area integral of the space time correlation can be obtained so that one shot estimates of forcing functions and true three-dimensional wave number components become possible, avoiding the prohibitive by expensive translation of point probes across the source area of interest. Because the optical wavelength can be chosen from any portion of the electromagnetic spectrum, this method offers a versatility and/or selectivity not available with any standard solid probe. Author

N66-35554*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

HOT WIRE TECHNIQUES IN LOW DENSITY FLOWS WITH HIGH TURBULENCE LEVELS

A. R. Hanson, R. E. Larson (Litton Systems, Inc.) and F. R. Krause *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 77–91 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

(Contract NAS8-11299)

Static and dynamic calibrations of modern hot-wire systems, which might be used in low density flows with high turbulence levels, are summarized. A review of hot-wire heat loss equations indicated that a time invariant frequency response can be obtained at high turbulence levels only if the probes are operated by constant temperature. The static calibration of two constant temperature hot-wire systems combined with hot-wire and hot-film sensors showed: significant changes in the calibration constants at low densities, a large increase of wall proximity effects at low densities, and considerable changes in the slope of the wire-resistance temperature relation especially at low temperatures. Dynamic calibration indicated that even the advanced constant temperature hot-wire systems are unable to resolve relatively high turbulent fluctuations in the reattachment region of free shear layers. Further improvements, possible by redesigning both the circuitry and the probes, are suggested. L.E.W.

N66-35555*# National Aeronautics And Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THEORY AND APPLICATION OF LONG DURATION HEAT FLUX TRANSDUCERS

S. James Robertson (Heat Technol. Lab., Inc.) and John P. Heaman *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 92–111 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

Presented in this paper are various devices and techniques for the measurement of heat flux. The principles of operation of the slug type sensor and the steady-state sensor are discussed, and certain design parameters for these sensors are presented. Special considerations for the application of both radiation and convection measuring devices, and the various types of heat flux simulators used in calibrating heat flux transducers are discussed. Author

N66-35587*# National Aeronautics and Space Administration, Washington, D. C.

ENVIRONMENTAL TESTING OF SATELLITE-BORNE INSTRUMENTS. SPACE RADIO PATROL

Kunio Hirao, Ken'ichi Maeda, and Tatsuzo Obayashi Jan. 1964 17 p Transl. into ENGLISH of Papers Presented at the 2d Informal Symp. on Artificial Satellites, Japan, 9 Aug. 1963 CFSTI: HC $1.00/MF $0.50

(NASA-TT-F-8580) CFSTI: HC $1.00/MF $0.50 CSCL 14B

CONTENTS:

1. ENVIRONMENTAL TESTING OF SATELLITE-BORNE INSTRUMENTS K. Hirao (Japan. Min. of Posts and Telecommunications) p 1–5 (See N66-35588 21-14)

2. SPACE RADIO PATROL K. Maeda and T. Obayashi (Kyoto Univ.) p 6–14 (See N66-35589 21-07)

N66-35588*# Japan. Ministry of Posts and Telecommunications, Tokyo. Radio Wave Research Inst.

ENVIRONMENTAL TESTING OF SATELLITE-BORNE INSTRUMENTS

Kunio Hirao *In* NASA, Washington Environ. Testing of Satellite-Borne Instr. Space Radio Patrol Jan. 1964 p 1–5 (See N66-35587 21-14) CFSTI: HC $1.00/MF $0.50

Results are presented for environmental testing of instruments aboard the four-stage high altitude Argo D-4 rocket, which was used in fixed-frequency topside sounding. Details are presented for the vibration testing in both vertical and horizontal directions, and mention is made of other testing conditions which would also approximate the severe environments that might be encountered by satellite-borne instruments. M.W.R.

N66-35591*# Arkansas Univ., Little Rock. Graduate Inst. of Technol.

BASIC EXPERIMENTAL RESEARCH LEADING TO IMPROVED COLD ELECTRON SOURCES AND NEW TYPES OF VELOCITY FILTER MASS SPECTROMETERS Final Report

M. K. Testerman et al 10 Apr. 1964 34 p refs

(Grant NsG-153-61)

(NASA-CR-56103) CFSTI: HC $2.00/MF $0.50 CSCL 20F

CONTENTS:

1. LISSAJOUS MASS SPECTROMETER–DEVELOPMENTAL RESEARCH R. L. Bond 9 p (See N66-35592 21-14)

2. A STUDY OF DIFFERENT DESIGNS OF COLD ELECTRON SOURCES CAPABLE OF MASS SPECTROMETRIC APPLICATIONS M. K. Testerman, R. W. Raible, B. E. Gilliland, J. R. Williams, and G. B. Grimes 22 p refs (See N66-35593 21-14)

N66-35592*# Arkansas Univ., Little Rock. Graduate Inst. of Technol.

LISSAJOUS MASS SPECTROMETER—DEVELOPMENTAL RESEARCH

R. L. Bond *In its* Basic Exptl. Res. Leading to Improved Cold Electron Sources and New Types of Velocity Filter Mass Spectrometers 10 Apr. 1964 9 p (See N66-35591 21-14) CFSTI: HC $2.00/MF $0.50

A mass spectrometer that has many theoretical advantages over other spectrometers for space research was experimentally investigated. It is a velocity filter device which derives its mass separation ability from the phase difference in ions traversing three stages of electrostatic deflection. Ions that have a pre-selected velocity, determined by a scan voltage, pass through a vertical and two horizontal deflection stages in phase with a 1.0 Mc sawtooth deflection potential applied between the plates of each stage. These resonant ions form a diagonal display (Lissajous pattern) on the collector. Non-resonant ions form similar displays on either side of the resonant ion display. The chief advantage of the Lissajous mass spectrometer over radio-frequency types is its long duty cycle. The duty cycle is limited only by the flyback time of the sawtooth deflection potential and this is only about 3% of the sawtooth cycle. The duty cycle is at least twice that of the Bennett tube. Author

N66-35593*# Arkansas Univ., Little Rock. Graduate Inst. of Technol.

A STUDY OF DIFFERENT DESIGNS OF COLD ELECTRON SOURCES CAPABLE OF MASS SPECTROMETRIC APPLICATIONS

M. K. Testerman, R. W. Raible, B. E. Gilliland, J. R. Williams, and G. B. Grimes *In its* Basic Exptl. Res. Leading to improved Cold Electron Sources and New Types of Velocity Filter Mass Spectrometers 10 Apr. 1964 22 p refs (See N66-35591 21-14) CFSTI: HC $2.00/MF $0.50

Various methods of providing cold electrons for ionizing neutral gas molecules in a mass spectrometer have been studied. These devices all belong to the general type in which a relatively weak current from a primary emitter is amplified by an electron multiplier. The multipliers used in this study were either conventional bucket-dynode or resistance-strip magnetic types. The final designs of the cold sources described here used tantalum photocathodes under ultraviolet irradiation as primary electron sources. The sources were found to be highly efficient, consume a negligible amount of power using sunlight, have minimal outgassing and gettering effects, and produce considerably less short term emission fluctuations when compared with a temperature-limited thermionic emitter. These devices would lend themselves well to calibration work and space-flight instrumentation. Author

N66-35618# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

FILM DOSIMETRY

J. S. Handloser *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 182-207 refs (See N66-28715 16-04) CFSTI: HC $6.00/MF $1.25

The changes occurring in photographic type emulsions with various amounts and types of ionizing radiation are examined. A calibration curve for the film, relating optical density to total exposure, is obtained. The energy response of emulsions for gamma rays, and the tracks caused by the action of neutrons on nuclear emulsions are studied. A calibration curve for emulsions relating the number of tracks to the number of neutrons, and neutron energies by analyzing the tracks in a thick emulsion are also obtained. Representative curves for optical density, energy response, and track length are given. For general information, see N66-35608. N.E.N.

N66-35634# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

APPLICATION OF THE GRAVIMETER FOR MEASUREMENT OF GRAVITY AT SEA

Shan-Yen Chang and Hsi-Chi Li May 1966 27 p refs Transl. into ENGLISH from T'se-Hui Hsueh Pao (Peking), v. 6, no. 2, May 1963 p 90-102

(ACIC-TC-1063; TT-66-61645; AD-634932) CFSTI: HC $2.00/MF $0.50

The major problem encountered in the application of the gravimeter for measurement of gravity at sea is the continuous effect of ocean waves and the motion of the ship on the instrument. Specific examples of these disturbances are the inclination of the ship, periodic horizontal acceleration and vertical acceleration, etc. In studying the effects of horizontal acceleration on gravity meter readings, discussion centers on long-period and short-period stable platforms. It is known from the results of investigation, that when the period of the stable platform is long enough, it is possible to cancel out the effects of horizontal acceleration. In the case of a short-period stable platform, it is imperative to take into consideration second-order correction for the horizontal acceleration; moreover, the correction induced by damping and the finite period of the stable platform must be taken into account. Furthermore, the effects of vertical acceleration on gravity meter readings, and cross-coupling effect, can be eliminated during construction of the instrument and in the measurement-taking process. At the same time, this paper also studies acceleration correction for relative motion of the ship and the earth, and the necessary depth correction and bathymetric correction for calculation of gravity anomalies. Author (TAB)

N66-35648*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOME PRACTICAL ASPECTS OF SURFACE TEMPERATURE MEASUREMENT BY OPTICAL AND RATIO PYROMETERS

J. Robert Branstetter Washington, NASA, Sep. 1966 71 p refs

(NASA-TN-D-3604) CFSTI: HC $2.50/MF $0.75 CSCL 20M

Techniques for obtaining the temperature of opaque materials by optical and ratio pyrometers are described. Fundamental equations of radiation are presented along with off-design corrections pertinent to pyrometer measurements. Characteristics of pyrometers both manual and automatic are discussed. Calibration apparatus and techniques are described. Techniques for minimizing temperature error resulting from small and/or awkardly located sources are analyzed. Also examined are the practical aspects of cavity-type sources. Precautions and procedures in the selection of emittance, reflectance, and transmittance data are included along with working curves helpful in deriving true temperatures from pyrometer-registered temperature readings. Author

N66-35650*# Astro Research Corp., Santa Barbara, Calif.

SOME PRELIMINARY DESIGN STUDIES FOR A VERY LARGE ORBITING RADIOTELESCOPE

W. M. Robbins, Jr. Washington, NASA, Sep. 1966 49 p refs (Contract NASw-852)

(NASA-CR-573) CFSTI: HC $2.00/MF $0.50 CSCL 20F

The size and surface accuracy required of a parabolic reflector to obtain a given angular resolution in a radio telescope is discussed briefly. The use of grating and grid surfaces for the parabolic reflector is examined and the effects of conductor diameter and spacing are given. The effect of ohmic resistance in the reflector surface is analyzed. The loads, stresses, and deformations caused by gravity gradient in a membrane-like reflector for an orbiting radio telescope with a diameter of 1500 meters are analyzed. Author

N66-35663*# Avco Corp., Wilmington, Mass. Research and Technology Labs.

FEASIBILITY STUDY OF AN OPTICAL RADIOMETER FOR DETERMINING THE COMPOSITION OF THE MARS ATMOSPHERE FROM SHOCK LAYER RADIATION DURING ENTRY, VOLUME II Final Report

J. A. Hull, R. N. Schweiger, and J. Shamsky May 1966 129 p refs

(Contract NASw-1208)

(NASA-CR-73027) CFSTI: HC $3.00/MF $1.00 CSCL 20F

This report describes the results of the instrumentation feasibility and development program. The instrument requirements are discussed considering both the experimental and engineering problems. Filters and sensors are examined in detail as to performance and survival of sterilization. Electronic circuitry is described and design considerations leading to choice of optical and electronic system configurations are discussed. A brassboard instrument was constructed and is described with some preliminary calibration and operational data given. An error analysis was performed to establish the accuracy requirements of the measurements. Author

N66-35671# Istituto Superoire di Sanita, Rome (Italy). Laboratori di Fisica.

AUTOMATIC APPARATUS FOR THE MEASUREMENT OF WEAK CURRENTS, PARTICULARLY SUITED FOR THE CALIBRATION OF RADIUM MEDICAL APPLIANCES [APPARATO AUTOMATICO PER LA MISURA DI DEBOLI CORRENTI E, IN PARTICOLARE, PER LA TARATURA DI PREPARATI DI RADIO]

F. Corti, C. Felici, and A. Vallone 22 Apr. 1966 29 p refs In ITALIAN; ENGLISH Summary

(ISS-66/17) CFSTI: HC $2.00/MF $0.50

The apparatus consists of two tunnel diode trigger circuits, in parallel, biased to different voltage and kept at constantly controlled temperature. The experimental results are displayed on a teletype, with the optimal punching of telex international code 5-channel paper tape. It is thus possible after tape-to-card conversion directly to feed the results to the electronic computer. Author

N66-35703# Norwegian Defence Research Establishment, Kjeller.

SPECIAL DIGITAL COMPUTER FOR PRECISION STEERING ON A RADIO TELESCOPE

Y. Lundh, E. Olsson, and K. Sostrand Dec. 1965 39 p refs

(NDRE-50) CFSTI: HC $2.00/MF $0.50

Complete steering system is outlined and detailed description is given of special digital computer for program steering based on predicted orbit positions. This remarkably simple and flexible system uses paper tape input data, and refers itself to absolute time by means of a built in high precision clock. Over-all steering accuracy ±2 min of arc plus possible errors in prediction. Author

N66-35748# Geological Survey, Washington, D. C.

PROPERTIES OF THERMISTORS USED IN GEOTHERMAL INVESTIGATIONS. PREPARATION OF THERMISTOR CABLES USED IN GEOTHERMAL INVESTIGATIONS

Eugene C. Robertson, Rudolph Raspet, Joel H. Swartz, and Major E. Lillard 1966 56 p refs *Its* Geol. Surv. Bull. 1203-B, C

GPO: HC $0.25

The advantages of using thermistors for measuring earth temperatures are discussed, and their characteristics are assessed in relation to the dependence of resistance on temperature and pressure. Details are also given on a study of the precision of temperature measurements by thermistors, and by the platinum thermometer used in all calibrations. Thermistor stability is considered, with thermistor drift ascribed principally to diffusion of impurity ions resulting from the passage of the electric measuring current. A simplified method for converting resistance to temperature is described; the master table and individual thermistor correction tables used in the technique are included. Procedures for calibrating thermistors at five temperatures are given, along with details on installing thermistors in multiconductor cables. Methods of handling, shipping, and care of thermistor cables are listed. M.G.J.

N66-35766*# Boeing Co., Huntsville, Ala.

ADVANCED SYSTEMS CHECKOUT DESIGN Fourth Quarterly Progress Report, Mar. 30–Jun. 29, 1966

29 Jun. 1966 12 p refs

(Contract NAS8-20240)

(NASA-CR-77522) CFSTI: HC $1.00/MF $0.50 CSCL 22D

Continued research designed to determine what checkout functions can and should be performed onboard the Saturn instrument unit and S-IVB stages, how these functions would be mechanized, and the impact of these changes on the presently planned Saturn V GSE and schedules; and efforts to develop design guidelines or requirements for incorporating the onboard checkout features, are reported. Summarized are data on the proposed onboard test system, program accomplishments, test equipment physical parameters, and a phase-in plan. An outline of implementation guidelines for incorporation into a space vehicle system, is included. S.C.W.

N66-35787*# Speedring Corp., Warren, Mich.

X-RAY TELESCOPE EXPERIMENT PACKAGE Final Progress Report, 12 Oct. 1965–15 Mar. 1966

[1966] 24 p

(Contract NAS5-9690)

(NASA-CR-77647) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Mechanical technology of the Aerobee 4.95 X-ray telescope instrument package is discussed, along with a description of the electronics of the instrument itself. The electronics for the aluminum and beryllium window proportional counters are described. Also discussed are the camera electronics and shutter control, and the performance of the instrument during pre-flight and flight tests. A photograph of the instrument package, and electronic circuit schematic diagrams of the instrument are presented. L.S.

N66-35805*# Bendix Corp., Davenport, Iowa. Pioneer-Central Div.

DEVELOPMENT OF OPTICAL LIQUID LEVEL SENSOR FOR USE IN LIQUID HYDROGEN Final Report, Jun. 1964–Oct. 1965

P. Lenker, R. Resh, W. Dray, N. Hosford, and R. C. Shearer 6 Jun. 1966 108 p *Its* Publ.-3464-1-66 Supersedes Publ.-3464-66

(Contract NAS8-11644)

(NASA-CR-77516) CFSTI: HC $4.00/MF $0.75 CSCL 20F

A program involved in the development of an optical liquid level sensor specifically designed for use in liquid hydrogen is described. The sensor, which uses solid state electronic components, operates over the temperature range of −225° to +50°C, has a sensing accuracy of ±0.1 inch, and a response time of nearly 4 milliseconds. It operates from 28 vdc with a 200 ma maximum current drain and furnishes an in-liquid or out-of-liquid electrical signal which may be used to switch an external 28 vdc load. During sensor development, operational characteristics of various electronic circuits and components were evaluated for satisfactory performance at liquid

hydrogen temperatures. Data obtained during these investigations are included. Comments and recommendations are also presented to further improve the sensor by reducing the size, weight, and power consumption of the units. R.N.A.

N66-35816# Los Alamos Scientific Lab., N. Mex.
CALCULATION OF THE PULSE-HEIGHT RESPONSE OF Ge(LI) SEMICONDUCTOR COUNTERS
Edward S. Fry, John M. Palms, and Robert B. Day 25 May 1966 33 p ref
(Contract W-7405-ENG-36)
(LA-3456) CFSTI: HC $2.00/MF $0.50

A Monte Carlo calculation was used to determine the pulse-height response of Ge(Li) detectors to gamma rays. A set of runs for three different crystal sizes and six different energies was made. The crystals were cylinders of length A and diameter A, where A was successively given the values 1 cm, 1 in., and 3 in. The source was a point source 10 cm from the end of the crystal, and the gamma-ray energies in MeV were 0.279, 0.412, 0.6616, 1.114, 2.7535, and 4.432. In addition to spectrum plots, there are plots of intrinsic efficiency vs energy and photo fraction vs energy for three crystal sizes. Author (NSA)

N66-35872# Battelle-Northwest, Richland, Washington. Pacific Northwest Lab.
PULSED REACTOR TESTS OF DOSIMETERS
P. E. Bramson and G. W. R. Endres 7 Jun. 1965 11 p
(Contract AT(45-1)-1830)
(BNWL-SA-27) CFSTI: HC $1.00/MF $0.50

Hanford Criticality Dosimeters, Personnel Beta-Gamma Film Badge Dosimeters and several types of experimental silicon diode neutron dosimeters were exposed to seven unshielded pulsed reactor bursts of between 0.24×10^{16} to 2×10^{16} fissions per burst. The exposures were made at the Sandia Pulsed Reactor Facility. Reported neutron doses between 40 and 2700 rads and the actual measurements were in agreement to within ±15% for the Hanford Criticality Dosimeter and to within ±25% for the criticality section of the Personnel Beta-Gamma Film Badge Dosimeter. The special silicon diodes were able to measure the fast neutron dose with an accuracy of about ±15%. The small base width (0.040") diodes provided good results to about 2500 rads. The large base width (0.07") diodes gave the best results between 20 and 200 rads. Glass rod dosimeters formulated from "high atomic number" glass provided measurements of the gamma dose agreeing to within ±30% of the reported dose. The errors stated for both the neutron dose exposures and the gamma photon exposures include any fundamental differences in absolute calibration that may exist between Hanford and Sandia Pulsed Reactor Facility. Each of the routine radiation monitoring instruments currently used at Hanford was tested for response to a single 0.1 μsec duration pulse of 600-keV X-rays from a Flash X-ray unit. Only the G.M. instruments failed to give a good indication that a radiation pulse occurred.
Author (NSA)

N66-35882# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
AVERAGE RADIUS GAGE
F. H. Broome 10 Jun. 1966 12 p ref
(Contract W-7405-ENG-26)
(Y-NA-18) CFSTI: HC $1.00/MF $0.50

An inspection gage was developed that utilizes an electronic integrator to determine the average radius of a near-circular section to within ±25 microinches as the surface is rotated before a gaging head. The gaging unit is automatic in its operation, is simple to calibrate and check, and eliminates the need for averaging calculations to obtain a precise answer. The unit is relatively small, can be easily transported from one gaging setup to another, and is adaptable for use with commercially available, high-precision electronic measuring equipment. Author (NSA)

N66-35907*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CRYOGENIC QUARTZ CRYSTAL MICROBALANCE
James B. Stephens *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 1-5 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

A quartz crystal vibrating in a thickness shear mode is frequency sensitive in a linear fashion to changes in mass and can thus measure the rate at which molecular flux condenses upon its surface at a particular temperature. The use of devices based on this principle are described. Cryogenic quartz crystal microbalances were used to obtain an absolute measure of the time rate of change of the mass per unit area of a condensing molecular flux. Two crystals mounted on the bottom of a liquid nitrogen cold trap, were used to monitor oil backstreaming of diffusion pumps and turbomolecular-impact pumps. It is pointed out that this condensible molecular flux detector will prove to be useful in understanding spacecraft contaminant migration and surface effect phenomenon. H.S.W.

N66-35922*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF PARTIAL-PRESSURE ANALYZERS
James M. Bradford *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting, Aug. 1966 p 129-130 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Advantages and disadvantages of three gas analyzers for partial-pressure analysis are reported. Operating characteristics of the omegatron in the ultrahigh vacuum range were investigated, and the instrument proved to be an excellent quantitative analyzer. The omegatron is usable down to about 2×10^{-11} torr, but is has a limited mass range. Two main problems were encountered in use of the 90° magnetic sector type analyzer: it could not be cleaned well and its sensitivity shifted after baking. The main advantage of the time of flight mass spectrometer was its flexibility for use in several modes of operation. An illustration showing the nude flight tube installed in an ultrahigh vacuum chamber is included. It was concluded that the time flight mass spectrometer gives the best all-around capabilities for partial-pressure analysis. S.P.

N66-35923*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELECTION AND USE OF A RESIDUAL GAS ANALYZER
William W. Hultzman *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 131-142 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Residual gas analyzers utilizing the mass spectrometer principle are examined with respect to the requirements of a vacuum system and instrument characteristics. Performance characteristics such as sensitivity, minimum detectable partial pressure, maximum operating total pressure, mass range, and resolution are briefly evaluated. Operating features including reliability, flexibility, convenience, and construction are also tabulated for several commercially available spectrometers. S.P.

N66-35924*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESIDUAL GAS ANALYSIS IN THE TEST AND EVALUATION DIVISION AT GSFC

Harold Shapiro *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 143–150 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Various applications are reviewed for residual gas analysis via mass spectrometry in areas of testing spacecrafts and their components. An international spacecraft designed for top side sounding of the ionosphere is used as a typical example of the value derived from testing components with a mass spectrometer. A suggested use of mass spectrometer analysis is in providing a fingerprint of commerical preparations and devices intended for use in a vacuum. The mass spectrometer was also used to recommend the best of three acceptable low vapor pressure greases used to lubricate a gimbal in a high vacuum chamber. S.P.

N66-35927*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AMES VIBRATING-ELEMENT PRESSURE GAGES

Robert J. Debs *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 169–174 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Continuing work on a vibrating-ribbon gage and a vibrating-diaphragm gage of lower pressure ranges is reported. The useful range of the vibrating-diaphragm pressure transducer was extended to pressures below 10^{-5} torr with a 30-micro-inch-thick diaphragm. Discussion centers on the vibrating-ribbon gage which is similar in operating principle to the vibrating-diaphragm gage; it is driven electrostatically by a voltage applied between the ribbon and a forcing plate on one side; the motion of the ribbon is sensed by measuring the capacitance between the ribbon and a sensing plate on the other side. Differences between the two gages are cited; and equations for the force acting on an electrostatically driven element moving sinusoidally are presented. In the case of the vibrating-ribbon transducer the higher mode frequencies are harmonically related to the fundamental resonance frequency, and the vibration amplitude closely approaches the total spacing. It was concluded that extensive tesing of the ribbon in such areas as repeatability and temperature effects is necessary. S.P.

N66-35928*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AREAS OF INVESTIGATION IN ULTRA HIGH VACUUM MEASUREMENT

David T. Pelz and George P. Newton *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 175–180 refs (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

A vacuum measurements program is presented to aid in understanding the response characteristics of vacuum ionization gauges to atmospheric gases. Efforts are focused on development of improved absolute calibration techniques to measure absolute atmospheric densities; the physical and chemical phenomena that occur in ionization gauges exposed to atmospheric gases; and measurement of pressures below 10^{-11} torr with cold cathode gauges, photocurrent suppressor gauges, and magnetic mass spectrometers. S.P.

N66-35929*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FLIGHT INSTRUMENTATION RESEARCH

Carl A. Reber and Dan N. Harpold *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 181–182 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

An experimental study is described for determining if rhenium wire filaments used in flight mass spectrometers generate carbon monoxide in an oxygen atmosphere. Other areas of flight instrumentation research include a program to increase filament lifetimes and to maintain a noncontaminating filament material. A method of generating a medium energy mono velocity dense neutral beam is briefly discussed. The method is to be used for testing the response of mass spectrometers on rockets and satellites to relatively high-velocity neutral particles (about 8 km/sec). S.P.

N66-35930*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXTENSION OF THE VOLUME-RATIO VACUUM GAGE CALIBRATION SYSTEM TO 10^{-9} TORR

Raymond Holanda *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 183–185 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Pressure ranges and estimated errors of calibration work performed using the volume-ratio technique are presented. The volume-ratio technique for vacuum gage calibration involves expanding a gas from a small volume at high pressure into a large volume which has been previously evacuated. A schematic diagram of the volume-ratio calibration system is presented and the test chamber is described. Commerical hot-filament ionization gages were calibrated in the system; large differences in calibration factors were observed between different gages along with various nonlinearity effects. The reproducibility (not the accuracy) of a typical ionization gage calibration curve was found to be about ±3 percent. S.P.

N66-35931*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF BAYARD-ALPERT GAGES IN ALKALI METAL VAPORS

Robert L. Summers *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 187 ref (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Observations of gauge performance in cesium and rubidium vapor are reported. In the apparatus used, high-purity alkali metal was inserted into and sealed within an ionization gage under high-vacuum conditions. Gauge response to changes in alkali metal vapor pressure, photoelectric currents, and gauge sensitivity measurements are briefly mentioned. S.P.

N66-35932*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ADHESION OF METALS IN ULTRAHIGH VACUUM

John P. Mugler and James M. Bradford *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 189–191 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Parameters that influence the adhesion process, such as the degree of surface contamination, are investigated. The limiting case of the clean surface is considered using tungsten. Photomicrographs of the sample indicate a high degree of adhesion. In the case of tungsten, adhesion between clean surfaces at low contact pressures was expected. Failure of tungsten to adhere is attributed to the compressive yield strength of the material after flashing in ultrahigh vacuum. Experiments with nickel are reported to support this contention that surface cleanliness is not the only important parameter for adhesion. The need for techniques to produce a clean surface is stressed for metals used in spacecraft construction. S.P.

N66-35938*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VACUUM REQUIREMENTS FOR HIGH-TEMPERATURE TESTING OF COLUMBIUM ALLOY SYSTEMS AND COMPONENTS

Charles A. Barrett and Louis Rosenblum *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 213-218 refs (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The effect of contamination of columbium at elevated temperatures in vacuum environments is determined. Contamination by impurities involves the processes of contaminants impinging and sticking to an exposed metal surface, and diffusion of contaminants from the metal surface to the interior. The oxygen flux that sticks to the surface is given by the Langmuir equation; and the pumping efficiency for a typical columbium alloy such as Cb-1Zr, which might be used in an advanced space power system, is determined. An experimental program is described for calculating the impurity weight gain as a function of time of Cb-1Zr specimens exposed at 980° and 1100°C to impurity gases at partial pressures of 10^{-5} to 10^{-7} torr. A photograph and a schematic drawing of the test setup accompany the discussion; and test procedure and results are briefly described. S.P.

N66-35940*# Parametrics, Inc., Waltham, Mass.
TECHNIQUES FOR MOUNTING AN ULTRASONIC TEMPERATURE DEVICE Final Report
L. C. Lynnworth and E. H. Carnevale Feb. 1966 95 p refs (Contract NAS3-6211)
(NASA-CR-54979) CFSTI: HC $2.50/MF $0.75 CSCL 14B

In order to apply the ultrasonic method of temperature measurement to rocket thrust chambers, special mounting techniques had to be developed. It was necessary to mount the transducer in such a manner that any sound transmitted around the periphery of the chamber would not affect the gas temperature measurement. A study of mounting methods applicable to Centaur and Nerva type combustion chambers showed that the acoustic short circuit problem can be overcome by using vane probes and a delay line mount. In certain cases, it may be possible to transmit across the exhaust gas, without separating the cooling tubes, as would be required for vane probes. In addition to studying mounting methods, ultrasonic probes, including transducers and flanges, were designed, developed and installed on a small hydrogen/oxygen rocket engine. Sound velocity was measured using an ultrasonic pulse technique up to ~6000°R. It was concluded that the ultrasonic pulse technique could be used to measure temperature in flowing hydrogen at high pressure in the 1000 to 5000° R range. Author

N66-35941*# Warner and Swasey Co., Flushing, N. Y. Control Instrument Div.
POSSIBLE TECHNIQUES FOR OPTICAL MEASUREMENT OF TEMPERATURE AND CONCENTRATION PROFILES IN A SUPERSONIC RAMJET
Burton Krakow, Richard H. Tourin, and Gunter J. Penzias [1966] 58 p refs
(Contract NAS1-5533)
(NASA-CR-66112; W&S-TR-39) CFSTI: HC $2.50/MF $0.75 CSCL 14B

The most likely possibilities of several spectroscopic methods for measurement of temperature and concentration profiles in a gas have been studied for possible application to an experimental hypersonic ramjet. Requirements and conditions of the ramjet restrict the solution of the measurement problem to a narrower range than would be considered for laboratory applications. The barriers to direct application of existing methods have been analyzed and new variations of these methods that may overcome these barriers have been devised. The discrepancy between available knowledge and that required by the new methods has been evaluated, the research needed to close the gap between them determined, and the effort involved estimated. Spectroscopic instrument technology is generally available for the optical measurements described in this report. Author

N66-35950*# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
TWO-GAS ATMOSPHERE SENSOR SYSTEM CONCEPTUAL DESIGN STUDY Final Report, Phase I
16 Mar. 1966 261 p refs *Its* Eng. Rept.-No. 8287
(Contract NAS1-5678)
(NASA-CR-66175) CFSTI: HC $3.75/MF $1.50 CSCL 20F

The use of a combined N_2-O_2 atmosphere in long-duration manned spaceflight missions requires the development of sensor instrumentation that will accurately measure partial pressures of the principal constituents in the mixed-gas cabin atmosphere. This instrumentation, designated as a two-gas atmosphere sensing system, provides the partial pressure information as an electrical signal for integration into a functional atmosphere control system. The design concept developed during this study program utilizes two sensor channels and a total pressure transducer to provide five different measurements (partial pressures of O_2, CO_2, H_2O, N_2, and total pressure) and electrical signals proportional to these measurements for interface with the cabin atmospheric-control system. The technique preferred and recommended for the sensor system is that of optical absorption. The radiant energy source for the O_2 and H_2O sensor operates in the ultraviolet spectrum at 1470 Å and the CO_2 sensor utilizes the 4.27μ band of the infrared region. The system will directly measure the partial pressure of O_2, CO_2, and H_2O using the optical absorption technique with accuracies of 2%, 2%, and 5% respectively. The system will also measure P_T with an accuracy of 1% and will compute the partial pressure of N_2 from these measurements to an accuracy of 5%. Author

N66-35951*# SDS Scientific Data Systems, Santa Monica, Calif.
DEVELOPMENT OF A TWO-GAS ATMOSPHERE SENSOR SYSTEM (MASS SPECTROMETER) Final Study Report, Phase I
31 Mar. 1966 318 p refs *Its* Book I
(Contract NAS1-5679)
(NASA-CR-66172) CFSTI: HC $4.25/MF $1.75 CSCL 20F

Results are presented of a study of a mass spectrometer Apollo spacecraft atmosphere sensor system applicable to mission durations of from 45 to 120 days. The system monitors the partial pressures of O_2, N_2, CO_2, and H_2O; and presents outputs which are suitable for input to existing types of atmosphere control devices and for telemetry and visual display. Major areas discussed include the design approach philosophy, boundary conditions and performance parameters, and a study of system components. Included in these discussions are a summary description of the entire system; consideration of operational characteristics, power, weight, and size requirements; environmental compatibility, reliability, maintainability, and calibration; and the state of development of the proposed instrumentation, its improvement potential, and adaptability. C.T.C.

N66-35977*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
IMPROVEMENTS IN STAGE CHECKOUT
R. L. Smith, Jr. *In its* Res. Achievements Rev. Ser. No. 10 1965 p 1-9 (See N66-35976 21-15) CFSTI: HC $2.00/MF $0.50

Four aspects of improving the checkout of space vehicle stages are discussed. A guideline document which takes into

account safety considerations, engineering modifications, checkout equipment, and the extent of detail required during checkout is explained. An evaluator of digital data, a computer method for instrument calibration, and automated control methods for stage checkout are included in the discussion. A presentation on checkout display requirements treats real-time running status, symptom and system information for troubleshooting, and assistance in test procedure generation. Display developments include cathode-ray screens for a matrix of variables, complex flow diagrams, and digital information storage. In single parameter testing, the appropriate combination of input and output signals for the precise computer identification of normal and faulty operation of various devices or systems is discussed. K.W.

N66-35989# Joint Publications Research Service, Washington, D. C.

EXPERIENCE IN THE APPLICATION OF SPECTROZONAL AERIAL PHOTOGRAPHS FOR TOPOGRAPHIC INTERPRETATION

V. Zh. Shoyvanov 31 Aug. 1966 11 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, Jun. 1966 p 48–51

(JPRS-37361; TT-66-33790) CFSTI: $1.00

Colored spectrozonsl photographs of 1:28,000 scale were evaluated topographically and compared with black and white negatives for possible surveying interpretation. A definite advantage over black and white photographs was found in the recognition of vegetation and hydrographic networks. In general, field traverse and laboratory interpretation of colored photographs together with photodiagrams increased the quality of interpretation. The extent of field interpretation traverses of spectrozonal aerial photographs could be safely reduced by 30 percent without a qualitative decrease in picture interpretation. G.G.

N66-35992# Bureau of Mines, Amarillo, Tex. Helium Research Center.

CALIBRATION OF A ROTATING PISTON DEADWEIGHT GAGE BY MEANS OF A MERCURY COLUMN LESS THAN 1 METER HIGH

Earl S. Burnett and Paul V. Mullins 1966 30 p refs

(BM-RI-6824)

Rotating piston deadweight gages have been used for many years for measurement of pressure to several hundred atmospheres. They have been calibrated by comparison of fluid pressures produced by various loads bearing on the piston bases, as measured by corresponding heights of balancing columns of mercury. When expressed in appropriate units, these ratios of column heights to piston loads are called piston constants. Experimental arrangements and procedures for their determination are presented in this paper, followed by a discussion of their significance and of their subsequent applications. Author

N66-36003# General Motors Corp., Indianapolis, Ind. Allison Div.

AN IMPROVED METHOD FOR MEASURING TURBINE VANE TEMPERATURES IN HOT CASCADE RIGS. HOT CORROSION IN TURBINE MATERIALS

W. L. Goodbar and P. E. Hamilton [1966] 27 p refs *Its* Vol. No. 11, 3d Quarter 1966

Combined infrared radiation and photographic techniques were utilized to measure the surface temperatures of turbine vanes in hog cascade test rigs. Observed infrared radiation intensity recorded on film was evaluated by isothermal mapping. Examples of data collected by this method are shown, and the effects of photographic parameters and obstruction in the optical path are discussed along with calibration techniques and accuracies. G.G.

N66-36012# Wyle Labs., Inc., Huntsville, Ala. Testing Div.

MEASUREMENT OF SONIC BOOM WITH LIMITED FREQUENCY RESPONSE INSTRUMENTATION—A THEORETICAL STUDY

M. J. Crocker Apr 1966 65 p refs

(WR-66-20)

The modifications of an ideal sonic boom, caused by various measuring systems with different frequency response limitations, are determined analytically. Measurement systems with low pass, high pass, and band pass frequency response characteristics are considered. The approach adopted is to obtain the Fourier transform of an ideal sonic boom by using the system frequency response function to predict the measured time history of the sonic boom. The measured time histories for each system are computed for various system cut-off frequencies. The computations indicate the effects upon the measured peak overpressure and upon the length of the positive and negative phases, due to limitations in frequency response of the measuring system. This work has useful applications in evaluating the accuracy of measurements made of sonic boom and it is recommended that practical measuring systems should have a linear frequency response with lower and upper cut-off frequencies of 0.05 and 10,000 cps respectively. Author

N66-36028# Ballistic Research Labs., Aberdeen Proving Ground, Md.

STRIP TRIANGULATION COMPUTER PROGRAM

Lila M. Butler Mar. 1966 127 p refs

(BRL-R-1318; AD-634915) CFSTI: HC $4.00/MF $0.75

This report presents an electronic computer program for the analytical treatment of a strip of photographs. The program will treat strips of photographs from three to thirty camera stations with two thirds overlap. The treatment of more than thirty camera stations can be achieved by modifing a few basic controls. Author

N66-36042# New York Univ., N. Y. Research Div.

OPTICAL SOUNDING II. PART II: THE PROBLEMS OF REMOTE OPTICAL PROBING OF THE ATMOSPHERE. SOME EXPERIMENTS ON THE INVERSION OF GROUND BASED RADIANCE MEASUREMENTS Final Report

E. E. Uthe [1965] 31 p refs

(Contract DA-36-039-AMC-03411(E))

(Rept.-65-7; AD-623478) CFSTI: HC $2.00/MF $0.50

Low level temperature profiles are inferred from simulated ground based atmospheric radiance measurements in the 4.3 micron CO_2 band. The inversion method compares these measurements with values obtained from a radiance model which is linearized by an assumed temperature profile T degrees P. An error term is added to the radiance measurements. The solution to the unstable system of equations is determined by minimizing the sum of the squares of the departures from the linearization profile T degrees P (Twomey, 1963). An iteration method is then used to correct the radiance model. Results indicate that profiles containing a first order discontinuity give satisfactory inversions when measurement and model errors are within 2 percent accuracy. Author (TAB)

N66-36054*# Rutgers Univ., New Brunswick, N. J. Dept. of Mechanical Engineering.

A COLOR SCHLIEREN SYSTEM

Thomas J. Kessler and William G. Hill, Jr. Nov. 1965 23 p refs *Its* Tech. Rept.-105-ME-F

(NASA-CR-77800) CFSTI: HC $1.00/MF $0.50 CSCL 14E

Details are presented on a color Schlieren system being developed to aid in the analysis of complex compressible fluid

flows. This system requires only small modifications to conventional Schlieren systems and provides excellent results. Several photographs comparing black and white with color results are presented. Author

N66-36055*# Massachusetts General Hospital, Boston. Radiology Dept.

SOLID CHEMICAL RADIATION DOSIMETER Semiannual Report

Majic S. Potsaid and S. Shibata 1 Jul. 1966 16 p refs

(NASA-CR-77801) CFSTI: HC $1.00/MF $0.50 CSCL 06R

The effects of temperature and X-irradiation strength on the acid production and color change in the Halogenated compound-Azo dye-Paraffin matrix, HAP, solid chemical dosimeter system were experimentally investigated. For the acid production studies a liquid paraffin was used in place of a solid paraffin to make the acid extraction more complete and reproducible. Chloroform was the halogenated compound used, and the dye was dimethylaminoazobenzene. The solid state of the mixture was obtained by cooling in a deep freeze. For the light transmittance measurement studies, paraffin was blended with chloroform and the dye at 65° to 70°C in making the translucent solid slabs. Data are given, showing the correlation of acid production with electron density and atomic number. The influences of physical state factors (concentration and type of organic compound used) on the peak response are also discussed. Several data curves depicting the radiation and concentration effects on the acid production and color change sensitivity are given. L.S.

N66-36064*# Chicago Univ., Ill. Lab. for Astrophysics and Space Research.

HIGH TEMPERATURE BEHAVIOR AND LONG-TERM STABILITY OF LITHIUM DRIFTED SILICON SURFACE-BARRIER DETECTORS

A. J. Tuzzolino, M. A. Perkins, and J. Kristoff [1966] 41 p refs Submitted for Publication

(Grant NsG-179-61)

(NASA-CR-77806) CFSTI: HC $2.00/MF $0.50 CSCL 18D

Lithium-drifted silicon surface-barrier detectors have been fabricated which exhibit stable electrical and α-particle characteristics under conditions of prolonged aging and repeated exposure to thermal-vacuum environments. The detectors will operate at a temperature of 85°C and high vacuum for several days and at a temperature of 100° C and high vacuum for several hours, with no evidence of noise instability. The operating characteristics of such detectors have been studied over a period of fourteen months. These studies include measurements of their electrical and α-particle characteristics taken before, during, and after extended thermal-vacuum testing at 50° C and 85° C, and short-term testing at 100° C. Degradation in electrical and α-particle characteristics resulting from such testing and aging was found to be negligible over the fourteen month time period. The α-particle measurements at 100°C indicate that the fractional change in the mean energy per ion pair in going from room temperature to 100°C is approximately −1.8%. The results of these studies are reported. Author

N66-36072*# Northwestern Univ., Evanston, Ill. Dearborn Observatory.

ELECTRO-OPTICAL SENSORS RESEARCH STUDY AND ASTRONOMICAL OBSERVATIONS Semiannual Progress Report, 15 Jun.–15 Dec. 1965

Jay Burns and J. Allen Hynek [1965] 11 p

(Grant NGR-14-007-033)

(NASA-CR-77863) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The progress of research is reported on astronomical observations of short period cluster variables, long time stability of performance characteristics of image orthicon tubes, and development of strong field magnetically focused image tubes. The search program for variable stars in galactic clusters is briefly described, with emphasis on the search procedures. A method for assessing image orthicon tube stability, which uses analytical photography to detect minute changes in photographs of a TV kinescope, was analyzed, and it was noted that the technique is a powerful one for detecting small changes in brightness or position in a complex picture. Problems which were encountered in arriving at a design for a cryostat to hold the superconducting solenoid to produce a strong magnetic field for an image tube are also discussed. A.G.O.

N66-36083*# Kansas Univ., Lawrence. Center for Research in Engineering Science.

RADAR SCATTEROMETRY—AN ACTIVE REMOTE SENSING TOOL

R. K. Moore [1966] 41 p refs Presented at the 4th Symp. on Remote Sensing of the Environment, Ann Arbor, Mich., 11–14 Apr. 1966

(Contract NSR-17-004-003)

(NASA-CR-77756; CRES-61-11) CFSTI: HC $2.00/MF $0.50 CSCL 17I

The radar scatterometer measures variation of the radar scattering coefficient with angle, wavelength, and polarization. These variations may be used by geoscientists to discriminate between surfaces with different roughness and materials. For example, such a system has been proposed to determine from a satellite the height of ocean waves, and from this to infer the wind field over the world's oceans. Radar scatterometers may be built using different combinations of angle, range, and speed measurement to discriminate among surface elements. Various systems are described, but only the range-angle system is studied in detail. The sizes of the areas sampled and the size of sample required for adequate statistics are described. Various data presentation methods are suggested. Author

N66-36161# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.

ION OPTICS OF MASS SPECTROMETERS. PART I: ELECTROSTATIC FIELDS

B. S. Prahallada Rao Jun. 1966 48 p refs

(AERE-R-5185) CFSTI: HC $2.00/MF $0.50

The ion optical properties of the electrostatic field analyser have been studied by several workers and appear mainly in the form of mathematical formulae. In this report some of these properties have been re-examined and presented graphically over ranges of values of several parameters and should be helpful in making a choice of these parameters for a design. Author

N66-36183# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

INFLUENCE OF THE CHANNEL WIDTH OF THE MULTICHANNEL ANALYZER ON THE SPECTROMETER RESOLUTION

Josef Kalisz Mar. 1966 12 p refs

(INR-694/III/PL) CFSTI: HC $1.00/MF $0.50

A method allowing evaluation of the influence of the analyzer channel width on the spectrometer resolution is described. The method is based on the assumption of Gaussian amplitude distribution at the analyzer input. Author

N66-36211# David Taylor Model Basin, Portsmouth, Va. Structural Mechanics Lab.

ANALYSIS AND HIGH FREQUENCY CORRECTION OF THE BAR-MAGNET VELOCITY-METER RESPONSE

J. D. Gordon Apr. 1966 30 p refs
(DTMB-2187; AD-634699) CFSTI: HC $2.00/MF $0.50

The output of the bar-magnet velocity meter, used to measure ship and model structural velocity transients due to the shock of an underwater explosion, is distorted by the electrical and structural characteristics of the meter. This report contains a derivation and analysis of the velocity-meter transfer function by treating the meter distributed mechanical system with Laplace transform techniques. The output signal distortion due to the high frequency structural resonances of the transducer is discussed. A practical way of compensating for this distortion is developed and demonstrated with an analog computer study. Conclusions drawn on theoretical grounds are then verified by tests on an actual velocity meter. The correction method derived is particularly well suited for use with analog computational procedures. Author (TAB)

N66-36284*# Aeronutronic, Newport Beach, Calif.
INSTRUMENT DEVELOPMENT FOR THE BASE FLOW REGION OF A MULTINOZZLE BOOSTER VEHICLE Final Report, 23 Jun. 1965–22 Jun. 1966
A. B. Bauer 22 Jun. 1966 72 p refs
(Contract NAS8-20503)
(NASA-CR-77911; U-3663) CFSTI: HC $3.00/MF $0.75 CSCL 14B

Described is the construction of a two wire probe capable of determining fluid velocity, pressure, density, and temperature in a flow field. The sensor utilizes the time a heated wake takes to travel between the wires to obtain the flow speed, and the direction of the wake behind the first wire to obtain the velocity vector direction. Also used are hot wire resistance measurements at two different heating currents to compute fluid pressure, density, and temperature. Example calculations for flow field measurements behind a cone showed that the probe can be used to measure flow speeds from almost 0 to over 2000 feet/sec. A machine program is required for rapid computation of the flow variables. G.G.

N66-36278# Argonne National Lab., Ill.
A TELEVISION SYSTEM FOR ULTRASONIC IMAGING
Harold Berger Jan. 1966 25 p refs
(Contract W-31-109-ENG-38)
(ANL-7042) CFSTI: HC $2.00/MF $0.50

The capabilities of continuous-wave, ultrasound, television imaging system as applied to several nondestructive testing problems are discussed. Application of the system to flaw detection is stressed, but some discussion and examples concerning the use of the system for other application areas, including liquid-level indication and fluid-flow studies, are also presented. It is concluded that, in the area of flaw detection, the television system offers particular promise for the ultrasonic inspection of thin, flat material. In inspections of objects of this nature, such as flat reactor fuel elements, the television system as normally used in these studies is capable of approximately one-mm resolution, of linear object inspection speeds of 120 cm/min, and of detecting such anomalies as bonding flaws, fuel inhomogeneities, and grain-size variations. The use of the television system in such inspection applications is recommended. Author (NSA)

N66-36280# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1965 IN THE PHYSICAL SCIENCES. VOLUME 4: INSTRUMENTATION
D. W. Pearce and J. K. Green, ed. May 1966 38 p refs
(Contract AT(45-1)-1830)
(BNWL-235, Vol. 4) CFSTI: HC $2.00/MF $0.50

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N66-36285# Union Carbide Nuclear Co., Oak Ridge, Tenn., Y-12 Plant.
AN AUTOMATIC FILM READER
J. L. Arrowood 20 Jun. 1966 41 p
(Contract W-7405-ENG-26)
(Y-1533) CFSTI: HC $2.00/MF $0.50

Automation techniques were applied to the digitizing of analog data recorded on positive transparent oscillograms. The system provides a rapid and economical method of obtaining accurate data from these oscillograms. Author (NSA)

N66-36300*# Westinghouse Electric Corp., Baltimore, Md.
ATTITUDE DETERMINATION BY KALMAN FILTERING, VOLUME I
James L. Farrell Washington, NASA, Sep. 1964 90 p refs
(Contract NAS5-9195)
(NASA-CR-598) CFSTI: HC $2.50/MF $0.75 CSCL 17G

To improve the reliability of satellite attitude determination systems, it is desirable to replace complex instrumentation by crude measuring devices with sophisticated data processing. A minimum variance scheme using magnetic and solar measurements is evaluated in a unified simulation applicable to spinning and nonspinning earth or sun orbiters. The simulation program obtains linearized ensemble statistics of the rotational uncertainties, and also generates a Monte Carlo sample which contains the effects of dynamic and geometric nonlinearities. The Monte Carlo sample is a reasonable member of the linearized statistical population, provided that certain favorable conditions are maintained. Specifically, the above-mentioned sources of nonlinearity must be minimized through the use of an appropriate dynamical formulation and through methodical restriction of measurement geometry. In connection with rotational dynamics it is noted that spinning orbiters are naturally associated with an inertial reference, whereas gravity gradient satellites are more readily compared with a local frame. The present unified formulation would presumably be sacrificed in actual operation, then, and the inertial formulation employed herein would be maintained only for spinning vehicles. The accuracy of locally linearized gravity gradient libration equations supports the concept of a local reference with minimum variance attitude determination for nonspinning satellites. Author

N66-36301*# Westinghouse Electric Corp., Baltimore, Md.
ATTITUDE DETERMINATION USING A KALMAN FILTER, VOLUME II
James L. Farrell Washington, NASA, Sep. 1966 77 p (Contract NAS5-9195) (NASA-CR-599) CFSTI: HC $2.50/MF $0.75 CSCL 17G

A description is given of a computer program for determining the attitude of an orbiting vehicle using a Kalman filter. The program obtains linearized ensemble statistics of the rotational uncertainties and, in addition, carries a Monte Carlo sample in which all dynamic and geometric nonlinearities are taken into account. This is accomplished by computing the measurement sensitivities, and the dynamical partial derivatives used for time extrapolation of error statistics, from an observed pattern of rotational motion with randomly generated errors carried through an actual nonlinear simulation. The program is written in Fortran IV for an IBM 7094 with subroutines in Fortran and Map. The naming of variables follows Fortran II conventions as to fixed and floating point names, with most floating point variables being typed double precision. C.T.C.

N66-36309*# Chicago Univ., Ill.
COSMIC-RAY TELESCOPE
J. A. Simpson and J. J. O'Gallagher *In* JPL Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 19–22 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

A description is given of the telescope designed to measure the absolute and relative flux levels, and the energy spectra of the two main components of primary radiation in the energy range from 1 to 170 MeV/nucleon. The theory of the small three-element energy-loss vs range telescope is summarized. The types of measurements are mentioned. The means of calibration, including both artificial pulse generation and energetic particle measurements using natural radioactive sources or accelerated particles from a laboratory accelerator, are outlinnd. N.E.N.

N66-36310*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COSMIC-DUST DETECTORS
D. K. Schofield *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 23–25 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The detector, used on Mariner IV and consisting of a single assembly containing a sensor and electronics in one chassis, is described. The functioning of the detector when a particle impacts the plate is outlined, and a block diagram is included. The instrument is designed to measure dust particle flux and mass distributions near Earth and near Mars. It is mentioned that measurements taken to date have revealed a dust concentration near Earth with a mass distribution different than that of interplanetary space. N.E.N.

N66-36311*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRAPPED-RADIATION DETECTORS
D. K. Schofield, D. Chinburg, and D. Enemark (State Univ. of Iowa) *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 26–28 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The objectives of the detector were identified as the measurement of radiation belts in the vicinity of Mars, and new measurements of the Van Allen radiation belts and interplanetary cosmic rays. The instrument consists of three Geiger-Mueller tubes for proton and electron detection, a solid state detector for proton detection, and a power supply. Brief descriptions of these and their operations are given. N.E.N.

N66-36312*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IONIZATION CHAMBER
L. G. Despain and H. A. Anderson *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 29–35 (See N66-35306 21-31) CFSTI: HC $3.00/MF $0.75

The chamber developed for the Mariner-Mars 1964 mission is described. The instrument package consists of the ionization chamber; a Geiger-Mueller tube; electronic circuits with power supply, amplifiers, and pulse shapers; and the chassis. Schematic and block diagrams are included, and the calibration is mentioned. The experimental objectives are outlined. The performance through the first 180 days and data obtained through the Van Allen Belts and during a solar flare are mentioned. N.E.N.

N66-36313*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLASMA PROBE
R. A. Graham *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 36–44 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The Mariner IV plasma probe, its components, and its operation are described, and a functional diagram is included. The measurement and calibration modes are discussed. The probe was designed to measure the density, velocity distribution, and bulk direction of the proton flux component of the solar plasma. Its failure eight days after launch was attributed to a radial ac field which set up between the resistor element and the surrounding circuits and chassis. N.E.N.

N66-36314*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MAGNETOMETER
David D. Norris, James L. Lawrence (Analog Technol., Inc.), and James S. Bunn *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 45–57 ref (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The magnetometer for taking magnetic field measurements during the Mars mission is described. Details are presented on the magnetometer sensor and the electronic modules. One module contains the power supply, ignition logic, rf power supply, and analog-to-pulse-width converters. The other module consists of the basic signal chain circuits and ancillaries. Circuit diagrams are included and the subsystem operation is outlined. The instrument is designed to determine the characteristics of the magnetic field if it exists, to investigate the nature of the boundary between planetary and interplanetry fields, and to measure the magnitude and direction of the interplanetary field components and their variation. N.E.N.

N66-36317*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLANETARY-SCAN SYSTEM
R. Y. Wong *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 78–85 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The system, designed to support the planet Mars encounter requirements, and its operations are reviewed. The searching, planet detection, planet tracking, and scan inhibit functions are summarized. Details are presented on the radiation detector which is to detect the presence and relative position of the planet. The dc outputs of the detector are converted to an ac signal by a pair of photomodulators, each consisting of a pair of small neon lamps and a matched pair of cadmium selenide photocells. The modulated X- and Y-axis outputs are amplified by a pair of four-stage ac preamplifiers. A schematic is included for the logic and control circuits. The motor assembly used to drive the instrument platform, and the system performance are mentioned. N.E.N.

N66-36344*# Aeronutronic, Newport Beach, Calif.

RESEARCH, DEVELOPMENT, AND PRELIMINARY DESIGN FOR THE LUNAR PENETROMETER SYSTEM APPLICABLE TO THE APOLLO PROGRAM Final Report, 15 Mar.–13 May 1966

3 Jun. 1966 178 p refs
(Contract NAS1-4923)
(NASA-CR-66179; U-3608) CFSTI: HC $3.25/MF $1.25
CSCL 22B

Presented are the analytical and conceptual design study results, preliminary functional specifications, test results, and test result evaluations obtained from a study of the application of the previously developed Lunar Penetrometers as sounding probes for a manned Apollo LEM landing. Among the results of the study were the findings that the sounding probe appears feasible, there is a limited range of possible launch times during the LEM descent trajectory, and penetrometer impact angles and velocities are relatively fixed for all favorable launch conditions. Emphasis in the study was placed on showing trade-offs available and system limitations rather than concluding with a fixed system design. Recommendations are made for possible module circuit improvements in the two prototype penetrometers evaluated. H.S.W.

N66-36345*# Aeronutronic, Newport Beach, Calif.

RESEARCH, DEVELOPMENT, AND PRELIMINARY DESIGN FOR THE LUNAR PENETROMETER SYSTEM APPLICABLE TO THE APOLLO PROGRAM Final Report, Apr. 1965–Mar. 1966

27 Apr. 1966 642 p refs
(Contract NAS1-4923)
(NASA-CR-66178; U-3556) CFSTI: HC $6.91/MF $4.25
CSCL 22B

A lunar penetrometer for accurate measuring of lunar surface characteristics for the first Apollo landing is described. Results of more than 200 impact tests conducted with accelerometer-instrumented spherical projectiles are reported in investigations of soil penetration characteristics. Development of the omnidirectional telemetering penetrometer assembly is summarized, and data relay equipment and associated communication analyses are described. Testing of communication link systems is reported, as well as the reliability analyses and predictions. Major accomplishments include development of a workable omnidirectional accelerometer and impact-insensitive telemetry system, accumulation of impact signatures characteristic of a wide range of material properties, simulation of LEM lunar landings, and demonstration of a complete communications link from multiple penetrometers. S.P.

N66-36354# Polish Academy of Sciences, Warsaw, Inst. of Nuclear Research.

A HALL-EFFECT PULSE MULTIPLIER FOR SPECTRA SELECTION OF DIFFERENT KIND PARTICLES [HALOTRONOWY MNOZNIK AMPLITUD IMPULSOW DO SELECKJI WIDM ROZNYCH RODZAJOW CZASTEK]

Teresa Kobe Mar. 1966 15 p refs *In* POLISH; ENGLISH summary
(INR-699(III)E) CFSTI: HC $1.00/MF $0.50

A multiplier of pulse amplitudes based on Hall-effect is described and its operation principle is given. The multiplier may be used for spectra selection of different kind particles. Author

N66-36358# Polish Academy of Sciences, Warsaw, Inst. of Nuclear Research.

SEMICONDUCTOR SPECTROMETERS OF PENETRATING NUCLEAR RADIATIONS DEVELOPED IN THE INSTITUTE OF NUCLEAR RESEARCH

J. Chwaszczewska, M. Dakowski, N. Przyborski, M. Sowinski, and A. Stegner Dec. 1965 21 p refs
(INR-681/IA, II/PS) CFSTI: HC $1.00/MF $0.50

The semiconductor spectrometers of penetrating nuclear radiation developed in recent years in the Institute of Nuclear Research are reviewed. The review includes guard-ring surface-barrier detectors, silicon and germanium lithium drifted detectors and windowless silicon surface barrier–lithium drifted detectors. The trends of development of the methods of semiconductor spectrometry are pointed out. Author

N66-36363# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

A PHOTOELECTRIC SYSTEM FOR MEASURING RATE OF APPENDAGE MOVEMENTS OF *DAPHNIA MAGNA*

J. W. Mc Mahon and J. F. Mac Donald Feb. 1966 15 p refs
(AECL-2411) CFSTI: HC $1.00/MF $0.50

An electronic system has been developed to give an accurate continuous measurement of the frequency of movement of the thoracic appendages of a zooplankter. The system employs a photocell which detects fluctuations in light intensity caused by movements of the animal's thoracic appendages, converts these to an electronic analog and plots this frequency on a continuously recording rate meter. A circuit diagram is provided and the calibration of the recorder is discussed. Author

N66-36383# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.

A QUANTISING HALF-TONE GENERATOR FOR FACSIMILE RECORDING

H. A. Cole Jun. 1966 26 p refs
(AERE-R-4878) HMSO: 4s 6d

An electronic unit is described which enable the amplitude of a continuously varying analogue signal to be quantised into six pre-selected channels within the range 0 to (+) 10v. The boundaries of the channels are defined by six discriminators which are connected via logic circuits to control the conduction of six associated current generators. The currents produced by the generators are used to produce a half-tone record on the chart of a facsimile recorder. By pre-setting the generator currents to represent a given amplitude channel, a quantised facsimile of the analogue signal may be produced in the form of a half-tone recording. Author

N66-36384# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

A TIME OF FLIGHT ENCODER USING INTEGRATED CIRCUITS

R. V. L'Archevêque and G. A. Leakey Jun. 1966 35 p
(AECL-2578) CFSTI: HC $2.00/MF $0.50

A time encoder was designed using monolithic silicon integrated circuits. The instrument, intended for neutron time of flight experiments, can measure the separation between a start pulse and one or more event signals from about 1 μs to 0.4 s. An internal 8 Mc/s crystal controlled oscillator provides excellent long term stability. Operation from an external clock is also possible up to 16 Mc/s. Numerous features were added to increase the flexibility of the instrument. A true binary read-out is generated in parallel and selection of the number of bits from 8 to 12 can readily be made from a switch on the front panel. Fourteen different values of channel widths are available from 0.5 μs to 48 μs in two ranges. The encoder can be preset to delay the counting from the start signal by up to 4096 channel widths. Choices of channel widths for the delay and the timing are completely independent. Under one mode of operation, the instrument can be dynamically tested using the light display on the front panel. The complete unit contains six printed circuit boards. Author

N66-36396# Kitt Peak National Observatory, Tucson, Ariz.
STABILIZATION AND ORIENTATION OF BALLOON-BORNE INSTRUMENTS
Russell A. Nidey [1965] 40 p refs Sponsored by NSF Preprint *Its* Contrib.-144

Detailed technical discussions are given of azimuth stabilization, elevation gimbals, error sensors, and examples of various balloon-borne control systems in the stabilization and orientation of balloon-borne instruments. Azimuth stabilization incorporates consideration of reaction wheels, motors, and perturbations. The examples given of instrument control systems include the solar azimuth pointing platform, the biaxial pointing control, stratoscope I, coronascope, stratolab, star gazer, BBSP-200, skytop, polariscope, and stratoscope II.
C.T.C.

N66-36401# Itek Corp., Palo Alto, Calif. Vidya Div.
OCEANOGRAPHIC SPECTRAL PHOTOGRAPHY. PART I: BASIC INVESTIGATIONS Final Report
E. Aubrey Bailey 29 Apr. 1966 118 p refs
(Contract Nonr-4786(00))
(VIDYA-219, Pt. I; AD-634748) CFSTI: HC $4.00/MF $0.75

This report presents the results of an investigation of the potential value of spectral multiband photography, and multiband imagery in general, for increasing the depth at which underwater objects and/or disturbances can be observed by aerial photography. The program included the collection of multiband photography over a series of selected targets, the special processing of this photography, and the analysis of the resulting displays. Special techniques developed by Itek Corproation for extracting spectral information from multiband photography are described and the results obtained with various techniques are illustrated. The special techniques suppress surface reflections while enhancing spectral differences among submerged objects, resulting in increased depths at which objects of bottom features can be differentiated. The most successful procedure tested made use of four spectral band and comparatively simple masking procedures to suppress surface reflections. The problem of observing subsurface disturbances such as produced by underwater explosions was considered, and theoretical calculations were carried out which indicate a limiting depth of approximately 30 feet for observing such a disturbance under optimum conditions in typical ocean waters.
Author (I.A.B)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-35348# Hauser Research and Engineering Co., Boulder, Colo.
SOME BALLOON MATERIALS TESTING METHODS
Ray L. Hauser *In* AFCRL Proc. AFCRL Sci. Balloon Workship, 1965 May 1966 p 11-22 refs (See N66-35346 21-02) CFSTI: HC $4.00/MF $0.75

Standard and novel test procedures that appear to be appropriate for balloon films are reviewed. The CRA and CRL test methods for axial breaking strength and breaking factor are compared. The apparatus for tensile and tear tests at −80° C is outlined. Current and future tests using biaxial stresses are described, and the projection is made regarding future quantitative tests of toughness at low temperatures.
Author

N66-35566*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ALUMINUM WELD DEVELOPMENT COMPLEX CONFERENCE
19 Jan. 1966 326 p refs Meeting held 19 Jan. 1966
(NASA-TM-X-57215) CFSTI: HC $4.25/MF $1.75 CSCL 13H

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N66-35568*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
STUDY OF THE MECHANISM OF POROSITY FORMATION IN WELDS
D. D. Pollock and W. V. Mixon *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 39-86 refs (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75
(Contract NAS8-11332)

Mechanisms responsible for porosity in aluminum welds are explained in terms of metallurgical phenomena and welding parameters. Emphasis is placed on the behavior of hydrogen and the way in which porosity forms and grows. Porosity effects in static fusion welds made with moisture contamination are considered. Response surfaces are determined for independent variables of water vapor present in the shielding gas, amperage, voltage as a function of arc-gap, arc-exposure time, and thickness of the material. The dependent variables used were percent porosity, solidification time, hydrogen content of a weld nugget, dendrite spacings and the number of pores in a volume equivalent of one gram cube of weld metal. Within the 95% confidence level, the degree of dryness of the shielding gas determined the extent to which porosity occurred. The same variables were considered for bead-on-plate welds. It was observed that the porosity of the bead-on-plate welds are considerably larger than that of the static welds.
S.P.

N66-35569*# Boeing Co., Seattle, Wash.
A QUANTITATIVE STUDY OF THE ROLE OF GAS CONTAMINANTS AS A SOURCE OF DEFECTS IN WELDS
W. Even Strobelt *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 89-104 ref (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75

The effects of gas contamination influx into the inert helium shielding envelope during production welding of aluminum are examined. Hydrogen, oxygen, nitrogen, and water vapor were used as the major variables; with other parameters such as voltage, amperage, joint preparation, and cleaning procedures being constant. The study was designed to determine the magnitude, frequency, and level of porosity that would result from the specific gas contaminants when introduced into the arc zone. The only physical property investigated was bend ductility. Efforts centered on determining the relationship of contaminants to weld characteristics, establishing a general concentration range of the contaminants requiring quantitative definition, and designing a quantitive study. It was concluded that all contaminants have an effect on weld quality and that the effect is not independent. S.P.

N66-35571*# Lockheed-Georgia Co., Marietta.

A STUDY OF INERT-GAS WELDING PROCESS TRANSFERABILITY OF SET-UP PARAMETERS

E. R. Seay *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 123–197 (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75
(Contract NAS8-11435)

Preliminary data is given from a study to determine and quantize the significance of inert gas welding variables, and to analyze the factors necessary for the successful transfer of weld settings which produce similar characteristics. The study concerned TIG welding in the horizontal position, and the welding programs were statistically designed so that the data could be obtained and analyzed using computers. The welding test procedures are outlined, and the parameter control studies are discussed. From the data obtained it was found that the variables that account for a majority of the variation in weld penetration are travel speed, current, tungsten tip diameter, and electrode position. The variables that affect TIG ultimate strength, porosity, and transferability are also summarized. Recommendations for further study are made. H.S.W.

N66-35572*# Harvey Aluminum, Torrance, Calif.

DEVELOPMENT OF CONTROLS FOR TIME-TEMPERATURE CHARACTERISTICS IN ALUMINUM WELDMENTS

D. Q. Cole and A. E. Bennet *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 201–237 (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75
(Contract NAS8-11930)

A summary is presented of the initial accomplishments made during a program to develop methods, tooling concepts, and processes to control the time-temperature characteristics in the weld and heat affected zone, in order to improve tensile properties and reduce porosity in aluminum weldments. Means of producing and controlling optimum thermal patterns were investigated by balancing heat input and heat extraction through the use of cryogenic liquids and auxiliary heat sources. Test data indicate that increased tensile properties and reduced porosity in weldments in 5/16 inch and 1/2 inch 2014-T6 plate have resulted from shortening the time temperature cycles and controlling the solidification pattern by using liquid CO_2 as a chilling agent during welding. H.S.W.

N66-35573*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

RELATIONSHIPS BETWEEN WELD QUALITY AND NON-VACUUM ELECTRON BEAM WELDING PROCEDURES

F. D. Seaman *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 241–301 refs (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75

Critical procedure details for non-vacuum electron beam welds have been identified and related to such qualities as undercut, bead width, contour and porosity. Welds that are consistant with actual quality standards have been peoduced. The strength of one-side one-pass welds produced exceeds the reported strength of TIG welds. Work has been accomplished on .250 inch 2219-T37 and is being continued to include .5 inch 2219-T37 and T87. Author

N66-35574*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.

PROTABLE INDUCTION BRAZING SYSTEM FOR AEROSPACE APPLICATIONS

Peter J. Tkac and Louis J. Lawson *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 305–320 (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75

The flexibility afforded by a portable induction brazing system for metallic tubing used in aerospace applications has been enhanced by the recent development of a compact, lightweight VLF power supply operating in the 3 to 15 Kcps region. The principles of induction brazing are discussed in this paper along with a consideration of the effects of frequency and tube geometry on depth of current penetration and thermal efficiency. The application of the new brazing power supply with both existing and anticipated brazing tools is described along with predicted improvements in induction brazing equipment. Author

N66-35655*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BLADE ELEMENT PERFORMANCE OF AXIAL-FLOW PUMP ROTOR WITH BLADE TIP DIFFUSION FACTOR OF 0.66

Max J. Miller and Donald M. Sandercock Washington, NASA, Sep. 1966 35 p refs
(NASA-TN-D-3602) CFSTI: HC $2.00/MF $0.50 CSCL 13K

A 9-inch-diameter axial-flow rotor with an 0.8 hub-tip radius ratio and a design diffusion factor of 0.66 at the rotor tip was tested in water. Detailed measurements of the radial distributions of flow conditions at the rotor inlet and outlet, and performance and flow parameters across a number of selected blade elements are presented at four levels of inlet pressure. Visual observations made during cavitating flow conditions are correlated with performance results. Secondary flows had a significant effect on blade-element flow and performance parameters. The rotor did not quite produce design head rise, primarily because measured deviation angles were higher than those predicted. Measured reference values of incidence angle (e.g., minimum-loss values) for each blade element were selected and compared with values computed from two-dimensional cascade correlations for the same flow and blade geometry. At design flow, inlet pressure was reduced in discreet steps until the overall head rise had decreased approximately 10 percent from the noncavitating value. Author

N66-35716# Argonne National Lab., Ill.

DESIGN AND OPERATION OF A PILOT-PLANT GETTERING SYSTEM OF TITANIUM-METAL SPONGE FOR REMOVAL OF NITROGEN FROM ARGON

M. L. Kyle, J. D. Arntzen, and L. F. Coleman Jan. 1966 46 p refs
(Contract W-31-109-ENG-38)
(ANL-7128) CFSTI: HC $2.00/MF $0.50

A pilot-plant scale unit designed to demonstrate the removal of low concentrations (less than 1%) of nitrogen from large, relatively pure volumes of inert gases was constructed and operated. The system utilized titanium-metal sponge at a temperature of 900°C as the gettering agent for removal of the

nitrogen impurity. Gas preheaters and regenerative heat exchangers were used to obtain better utilization of the titanium sponge and to provide heat economy. The pilot-plant unit operated at a flow rate of 10 cfm of argon containing 100 to 1000 ppM nitrogen for a period of about 1800 hr. Operation of the system was terminated because of the deterioration of the shaft seals on the gas-circulating blower. This deterioration is believed to be the result of prolonged exposure of these seals to a low-water, low-oxygen-concentration atmosphere. During the 1800 hr of system operation, all equipment items except the blower performed their design functions well. The pilot-plant unit successfully demonstrated the usefulness and relative economy of titanium-metal sponge as a gettering agent for nitrogen impurity in argon. The performance of the equipment is assessed, and recommendations for design of large, inert-gas purification systems are presented.
Author (NSA)

N66-35792*# Chrysler Corp., New Orleans, La. Space Div.
QUALIFICATION TEST OF SATURN S-IB STAGE LOX REPLENISHING VALVE /60C20457/
R. M. Dale 9 Jun. 1965 80 p refs
(Contract NAS8-4016)
(NASA-CR-77656; TR-RE-65-54; AD-483718L) CFSTI: HC $3.00/MF $0.75 CSCL 13K

Qualification tests were carried out a Saturn S-IB stage LOX two-inch, nominal diameter, bidirectional replenishing ball valve 60C20457. The valve weighs ten lbs and measures 7×8.8×9 inches. It is spring loaded, and opened by a pneumatic control piston assembly (it is normally closed). Tests conducted included: (1) flow chamber and control piston proof pressure, (2) functional, (3) dielectric strength, (4) high temperature, (5) humidity, (6) salt spray, (7) vibration, (8) impact shock, (9) life cycle and (10) flow chamber and control piston burst tests. Valve 60C20457 met the qualification requirements of procurement specification 60C26012, with the exception of shaft seal leakage. The rms finish of the shafts for the tested samples failed to meet vendor drawing requirements. When reworked to meet or exceed the finish requirements, the leakage stopped. Photographs of the valve, valve components, and test set-ups are given; and data sheets are included.
L.S.

N66-35820# Atomics International, Canoga Park, Calif.
ZONE MELTING OF URANIUM MONOCARBIDE
G. Ervin, Jr. and A. K. Smalley 25 May 1966 26 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11813) CFSTI: HC $2.00/MF $0.50

Two furnaces for float-zone melting are described briefly, and data on zone melting of UC are presented. Induction zone melting of UC in a He atmosphere does not cause much loss of U by preferential vaporization, and it was therefore possible to make use of the compositional changes along the length of the zone-melted rod to calculate distribution coefficients for excess U and C in UC. These distribution coefficients indicate the shape of the U–C pnase diagram in the neighborhood of the melting point of UC. Electron beam zone melting in vacuum produced single crystals of UC, normally containing UC_2 as a second phase; but, at fast transverse rate, the evaporation of U was minimized and single-phase single crystals of UC were produced.
Author (NSA)

N66-35848# Los Alamos Scientific Lab., N. Mex.
THE RESPONSE OF PRESSURE TRANSMISSION LINES
Geoffrey P. Watts [1965] 11 p refs Presented at Instr. Soc. of Am., 20th Ann. Conf., Los Angeles
(Contract W27405-ENG-36)
(LA-DC-7025; CONF-651002-5) CFSTI: HC $1.00/MF $0.50

Due to environmental factors, it is often necessary to separate a pressure transducer from the region in which pressure is to be measured. Pressure lines are then required to transmit the pressure to the pressure transducer. Equations describing the response of pressure lines have been derived by Iberall, and are sufficiently complicated that they have never had wide use. A digital computer code was devised which calculates pressure line response using Iberall's equations. Laboratory experiments were conducted using condenser microphones to measure the response of 1/4 inch and 3/8 inch outside diameter tubes containing atmospheric air. Frequency response data obtained in the 10 to 2000 cps region. Reynolds numbers in the tubes were held below 2000. The experimental and calculated results agree to within the experimental accuracy for 4 and 8 foot long tubes. Considerable error is evident, however, when tubes as short as 6 inches are used.
Author (NSA)

N66-35878# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation
PROPERTIES OF SOME REFRACTORY METALS. IV: EXPERIMENTAL TECHNIQUES EMPLOYED IN STRESS-RUPTURE AND CREEP MEASUREMENTS TO 3000°C
W. L. Mc Cullough and P. N. Flagella 29 Apr. 1965 38 p ref
(Contract AT(40-1)-2847)
(TM-65-5-10; TID-22986) CFSTI: HC $2.00/MF $0.50

Equipment and techniques were developed for the measurement of refractory metal creep-rupture properties to 3000°C in hydrogen or inert atmospheres. The furnace, using a split tungsten tube as the heating element and heated resistively, is capable of operating at constant temperature continuously for hundreds of hours. Temperature control within 10°C is obtained by automatically maintaining a constant voltage to the heating element. Temperature is determined by sighting an optical pyrometer into a black-body tube located adjacent to the test specimen. The dead weight load, imposing the desired stress on the test specimen, is suspended below the furnace in the load shell which also contains the furnace atmosphere. Strain measurements are obtained using a special optical extensometer consisting of two parallel telemicroscopes. Each telescope is focused on a 0.005-inch-diameter hole, used as a fiducial mark, at either end of the specimen gage length. Creep data for arc-cast molybdenum at 2200°C, obtained with the optical extensometer, are presented demonstrating the excellent temperature control and reproducibility of test data obtained.
Author (NSA)

N66-35880# Minnesota Mining and Mfg. Co., St. Paul, Minn.
FABRICATION OF TUNGSTEN ALLOY TUBING Progress Report, 2 Feb.–1 May 1966
H. G. Sowman, A. Milner, and D. D. Rowenhorst 10 May 1965 15 p refs
(Contract AT(11-1)-1518)
(COO-1518-3) CFSTI: HC $1.00/MF $0.50

W–26% Re tubing up to 11 in. long was fabricated. The feasibility of using prealloyed powders in the tube extrusion process was shown. Structures similar to those obtained from elemental powders were obtained. Tensile data obtained on W–26% Re alloys from sintered elemental powders gave ultimate tensile strength values of 175,000 psi and 9% elongation at room temperature.
Author (NSA)

N66-35918*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A LOW-TORQUE SUPPORT FOR LOW THRUST MEASUREMENT AND ATTITUDE CONTROL TESTING

Edward W. Otto *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 95–100 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

A three-axis gas bearing was employed as a low-torque support system to study spacecraft attitude-control systems in a simulated space environment. The bearing is mounted in the 15 by 60 foot high vacuum facility, where the necessary vacuum environment is provided for proper testing of thrustors, which include ion-engine systems. In order to avoid degradation of the chamber vacuum because of discharge of gas from the bearing into the chamber, the bearing is equipped with a separate vacuum scavenge system. The performance and the effect on environmental test chamber vacuum of this gas bearing are described. Author

N66-35835*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INFLUENCE OF A VACCUM ENVIRONMENT ON FRICTION AND LUBRICATION STUDIES

Donald H. Buckley *In its* High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 201–211 refs (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

The importance of a clean vacuum system on the friction characteristics of metals in sliding contact is discussed, and friction and mass spectrometer data are presented. Furthermore, the influence of vacuum system total and oxygen partial pressures is shown to affect markedly the friction behavior of metals in sliding contact. The relation of metal oxide stability to oxygen partial pressures and friction characteristics of metals is also discussed. The poor heat dissipation for materials in a vacuum is shown to affect the temperatures of sliding contact metals in friction studies. This poor heat dissipation is also related to the mechanisms of degradation of materials such as polytetrafluoroethylene in friction experiments. Author

N66-35976*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

RESEARCH ACHIEVEMENTS REVIEW SERIES NO. 10

Ernst Stuhlinger 1965 40 p

(NASA-TM-X-53466) CFSTI: HC $2.00/MF $0.50 CSCL 13H

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1. IMPROVEMENTS IN STAGE CHECKOUT R. L. Smith, Jr. p 1–9 (See N66-35977 21-14)

2. IMPROVEMENTS IN STRUCTURAL NONDESTRUCTIVE TESTING R. W. Neuschaefer p 11–19 (See N66-35978 21-32)

3. IMPROVEMENTS IN ELECTRONIC COMPONENT TESTING M. J. Berkebile p 21–29 (See N66-35979 21-09)

N66-36006# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.

AN INVESTIGATION OF PITTING AND SHELLING FAILURES IN ROLLING CONTACT

Tetsuichi Mitsuda Sep. 1965 152 p refs Sponsored by Assoc. of Iron and Steel Engr.

(T&AM-286)

An investigation of the problem of shelling in crane wheels has been conducted by means of simplified laboratory models. Complex factors of loading and shape have been eliminated to focus attention on free rolling and rolling with tangential tractive forces. Analytical solutions for rolling contact are based on elastic considerations but both prototype and model are subject to severe plastic strains which cause a rapid decrease in initial Hertz stresses. An approximate solution is compared against model observations to establish the order of magnitude of decrease in stress. Attempts have been directed toward obtaining shelling or pitting failures in the unlubricated or dry condition. Phenomenological differences between lubricated and dry specimens are cited and reasons for the necessity of a lubricant to cause pitting are given. The significance of dry damage cycles prior to lubrication in the pitting life of a specimen has been investigated both in free rolling and with tangential forces. The influence of slip in causing early pitting failures has been investigated, leading to questions on effects of track geometry in causing pitting in free rolling. Rapid pitting obtained by a process of dry run-in, dry friction and lubricated free rolling indicates that with further development it could possibly be used as a relatively rapid testing method to compare the pitting resistance of various materials in rolling contact. Author

N66-36048*# Alabama Univ., University. Bureau of Engineering Research.

[STUDY OF THE STABILITY OF THE S-IC OPEN LOOP PROPELLANT-HYDRAULIC SYSTEM Quarterly Report No. 7

27 Jun. 1966 17 p refs

(Contract NAS8-11341)

(NASA-CR-77881) CFSTI: HC $1.00/MF $0.50 CSCL 09E

An analytical geometric approach to determining if significant forces could be generated by the movement of one servoactuator, transmitted through the mechanical linkage to the piston of the other servoactuator, thereby creating a pressure surge of sufficient magnitude to cause structural failure of hydraulic components is given. The point mass of the engine was described with respect to different coordinate systems. The calculations are worked out, and show that there does not appear to be any danger of a high pressure surge being developed through the mechanical link. L.S.

N66-36049*# IIT Research Inst., Chicago, Ill. Technology Center.

STUDY OF FACTORS AFFECTING CHEMICAL MILLING Final Report, 1 Jun. 1965–1 Jun. 1966

Howard T. Francis 30 Jun. 1966 102 p refs

(Contract NAS8-20112)

(NASA-CR-77880; IITRI-B6049-12) CFSTI: HC $4.00/MF $0.75 CSCL 13H

Factors affecting the chemical milling characteristics of aluminum alloy types 2219, 2014, 5456, and 7075 were studied. The cause of nonuniform stock removal for type 2219, the relation between stretch marks and milling uniformity for type 5456, and the causes of rough etching in types 2014 and 7075 were investigated. Certain recommendations are made for improvements in the milling process. Also discussed are quenching rate, cold working, hardness, and aging factors. Metallographic examinations are also described. L.S.

N66-36066# Naval Ordnance Lab., White Oak, Md.

POLISHES AND ETCHES FOR TIN TELLURIDE, LEAD SULFIDE, LEAD SELENIDE, AND LEAD TELLURIDE: SUPPLEMENT Final Report, Jun. 1963–Feb. 1966

Marriner K. Norr 17 Mar. 1966 17 p refs

(NOLTR-66-32; AD-484038)

This report is a continuation of NOLTR 63-156 (AD-423 367). Together, the two reports present a review of chemical and electrolytic polishes and dislocation etches for SnTe, PbS, PbSe, and PbTe, covering the period from 1907 through 1965. The present report also describes a new polish and a new dislocation etch for tin telluride, as well as tests on and improvements in some of the polishes reported in earlier publication. Author (TAB)

N66-36071*# National Aeronautics and Space Administration, Washington, D. C.

PREPARATION OF CONTRACTOR QUALITY PROGRAM PLAN

George A. Lemke 31 Jan. 1966 14 p
(NASA-TM-X-57879; RA-001-007-1) CFSTI: HC $1.00/MF $0.50 CSCL 13H

A guideline is presented to assist in the preparation of the final quality program plan required from space system contractors. The plan is a documented description of the contractor's program for implementing the quality provisions of the contract. An outline is provided with a brief description of the quality assurance elements that must be included in the quality program plan. Elements such as inspection and test planning, change control, quality program documentation, process control, material control, personnel training, and process certification are discussed. A.G.O.

N66-36163# Atomic Weapons Research Establishment, Aldermaston (England).

THE METALLISING OF CERAMIC WHISKERS

R. B. Barclay and C. A. Calow Feb. 1966 16 p refs
(AWRE-O-18/66) HMSO: 3s 3d

This report describes results of preliminary experiments with electroless plating and vapor plating from nickel carbonyl of silicon nitride whiskers. Coatings produced by the electroless process were unsatisfactory. The vapor deposited nickel coating process was promising and this method is to be pursued, as ore ion sputtering techniques. Author

N66-36168# Technische Hogeschule, Delft (Netherlands). Laboratorium voor Verbrandingsmotoren en Gasturbines.

DESIGN AND DEVELOPMENT OF ROTATING SLIPRING ASSEMBLY FOR COOLED GASTURBINE BLADE TEMPERATURE MEASUREMENTS

V. A. Ogale Dec. 1965 33 p refs
(REPT.-10.E.010) CFSTI: HC $2.00/MF $0.50

The slipring assembly design was based on the following requirements: satisfactory calibration characteristics, suitable for use on the experimental laboratory gas turbine testrig, and moderate wear of sliprings and brushes. It was found that in the calibration of the rotating thermocouple, the brush loading was an important factor. It was determined that an error of the thermocouple system is less than 1% between 2000 and 10,000 rpm at 200° C. The components of the rotating slipring assembly are described, and the accuracy of the whole assembly was found to be ±1% at constant temperature. N.E.N.

N66-36169# National Engineering Lab., Glasgow (Scotland).

THE DESIGN AND PERFORMANCE TOOLING FOR THE COLD EXTRUSION OF STEEL

Oct. 1965 40 p refs Presented at the Inst. of Sheet Metal Eng. 3d Intern. Conf. on the Cold Extrusion of Steel, Eastbourn, Gt. Britain, 2-4 Nov. 1965
(NEL-197)

The performance of a few selected steels as punches in the backward extrusion of cans has been investigated to a limited extent under arbitrary but repetitive working conditions. Under these conditions the punches made from high-speed tool steel were superior to those made from high-carbon high-chromium tool steel. The preforming of a depression on the top face of the billet improved punch performance and concentricity of the product. A method is given of determining the optimum mating diameters of multiring extrusion containers and dies and of the interference required. For a given working space and choice of materials the three-ring container could withstand significantly higher pressures than the two-ring container. An analysis is given of the design of a novel segmented container which seems to have advantages over the conventional container and in addition would permit the use of very high strength materials such as tungsten carbide. Author

N66-36283# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.

SINGLE-TRANSDUCER DIFFERENTIAL MEASURING DEVICE

L. G. Whitten 21 Jun. 1966 7 p
(Contract W-7405-ENG-26)
(Y-1541) CFSTI: HC $1.00/MF $0.50

A review of current practice showed that to keep abreast of present-day machine-tool capabilities, the precision of on-the-machine gaging should be improved by at least an order of magnitude. A simple, easily operated, portable, on-the-machine measuring device utilizing a single-transducer measuring system was designed, built, and tested. Its performance demonstrated an improvement in precision over current practice by one to two orders of magnitude. Author (NSA)

N66-36284# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.

THICKNESS MEASUREMENTS BY NONDESTRUCTIVE TESTING METHODS

R. E. Cofield 21 Jun. 1966 15 p
(Contract W-7405-ENG-26)
(Y-1535) CFSTI: HC $2.00/MF $0.50

Dimensional parameters such as thickness can frequently be measured by nondestructive testing methods, which are normally used for the evaluation of internal quality. These methods generally respond to the nature of the test object material rather than merely to the relative location of its surfaces. Thus, many of the techniques can measure thickness when only one surface is accessible or when the thicknesses of several layers of materials are involved. Tangential-projection radiography, narrow-beam radiation absorption gaging, radiation backscatter, electromagnetic induction, microwave interaction, and ultrasonic wave propagation are practical thickness-measurement techniques that are discussed. Author (NSA)

N66-36352# Royal Aircraft Establishment, Farnborough (England).

INVOLUTE TEETH FOR PARALLEL AXES WITH PINION TOOTH NUMBERS FROM 1-7

Karlheinz Roth May 1966 36 p refs Transl. into ENGLISH from VDI Z. (Dusseldorf), v. 107, no. 6, 1965 p 275-284
(RAE-Lib-Trans-245) CFSTI: HC $2.00/MF $0.50

The size of a transmission may be reduced by the use of small gear teeth and the choice of small tooth numbers which results in larger module values and therefore gears with a greater load capacity and a reduction in noise. A 20° involute gear system with parallel axes is described, with straight-toothed and helical-toothed pinions having one to five teeth. Author

N66-36374*# Alabama Univ., University. Bureau of Engineering Research.

[STUDY OF THE STABILITY OF THE S-IC OPEN LOOP PROPELLANT-HYDRAULIC SYSTEM Quarterly Report No. 6

[1966] 36 p
(Contract NAS8-11341)
(NASA-CR-77907) CFSTI: HC $2.00/MF $0.50 CSCL 13G

The response of the system to a step input command signal over an operating range from 0.50 degree to 3.00 degrees is presented. An analysis of the data shows that a significant change in the dynamic behavior occurs between an input command of 1.0 degree and 1.25 degrees. Tests were conducted to gain some insight into this phenomenon and the data obtained are graphically shown. H.S.W.

N66-36388*# IIT Research Inst., Chicago, Ill.
BACKSTREAMING FROM OIL DIFFUSION PUMPS Final Report, Dec. 1, 1963–May 30, 1966
William M. Langdon and Victor R. Ivanuski 1 Jul. 1966 184 p refs
(Contract NASr-65(08))
(NASA-CR-77934; IITRI-C6030-10) CFSTI: HC $5.00/MF $1.25 CSCL 13K

The oil diffusion pumps studied covered the variables: pumps—fractionating and nonfractionating; baffles—right angle elbow, CVC BC-61, NRC HN-6, and G/P cryosorb; oils—DC 705, convalex 10, and OS 124; and operational procedures. Optimum operating conditions resulted in no detectable increase in the 1 monolayer of oil which forms during the bakeout period. This result can be obtained routinely with either pump, all three oils, and two out of four baffles. The backstreaming contamination in turbomolecular pumps was also found to be on the order of 1 monolayer. However, the analytical methods showed the presence of an interfering substance, presumably unsaturated hydrocarbons from the lubrication process, which could not be removed by prolonged bakeout at 212°C. Backstreaming of the volatile lubrication oil can occur on startup and shutdown unless special procedures were used which involved for pressures of several torr when the pumping rotor was below operating speed. Author

N66-36422*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ESTABLISHING A COMMON DENOMINATOR IN WELDING
Gordon Parks *In its* Mfg. Res. at MSFC 1965 p 15–20 (See N66-36420 21-34) CFSTI: HC $2.00/MF $0.50

The common denominator of time–temperature relationship is discussed as an approach to welding fundamentals. It is pointed out that this basic relationship can be applied to various welding parameters to obtain better systemized information, e.g., optimum time-temperature curves for yield strength, ultimate tensile strength, elongation, porosity, distortion, and material thickness. The common denominator is then discussed in relation to the various means of welding, i.e., inert gas arc welding and electron beam welding. Three conceptions of the electron beam method are summarized: the split or local chamber method in which only the joint to be welded is in vacuum, the plasma electron beam system in which a hollow electron gun operates in a low vacuum provided by a mechanical pump, and a nonvacuum system in which the material to be welded is in a normal atmosphere and the facuum is maintained within the electron gun. L.E.W.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-35529# Pennsylvania State Univ., University Park. Dept. of Physics.
BRILLOUIN SPECTRA OF LIQUIDS USING He–Ne LASERS
D. H. Rank, Edward M. Kiess, Uwe Fink, and T. A. Wiggins *In its* Opt. Phenomena in Liquid and Gaseous 13 p refs See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

Brillouin spectra of six liquids, acetone, ethyl alcohol, water, carbon bisulfide, toluene and carbon tetrachloride have been obtained using a He-Ne laser as the light source and employing photoelectric detection. The velocity of sound has been measured with a precision of ± 0.2 per cent in most cases. The intensities of the central component and the Brillouin components have been measured. Since the liquid samples were prepared so that they were sensibly optically empty, a comparison of the intensities can be made with the theoretical predictions of Landau and Placzek. Author

N66-35530# Pennsylvania State Univ., University Park.
STIMULATED BRILLOUIN SCATTERING IN LIQUIDS
T. A. Wiggins, R. V. Wick, D. H. Rank, and A. H. Guenther (AFSC, Kirtland AFB, N. Mex.) *In its* Opt. Phenomena in Liquid and Gaseous Media [1965] 10 p refs Prepared in Cooperation with AFSC, Kirtland AFB (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

Stimulated Brillouin scattering in liquids has been observed in an arrangement whereby the laser pulse can be time resolved from the pulses which are back-scattered into the laser and reamplified. The results show that the reamplified pulses can make the energy as measured by calorimeters or other integrating devices appear as much as several times the original laser energy. The time between the original pulse and the reamplified pulse depends only upon the distance between the laser and the scatterer. Extrapolation to zero distance indicates that the reamplification requires less than a few nanoseconds. Scattering from a number of liquids was observed. Analysis of Fabry-Perot ring systems gave frequency displacements sensibly the same as determined by more precise techniques. Only weak pulses reamplified by the laser could be detected when a plane mirror was used instead of a liquid scatterer. It appears that the Brillouin shifted wavelength causes amplification in a different laser mode which has not been depopulated in the original pulse. Author

N66-35531# Pennsylvania State Univ., University Park. Dept. of Physics.
LASER INDUCED BREAKDOWN IN OXYGEN GAS AT HIGH PRESSURE
T. A. Wiggins, R. V. Wick, D. H. Rank, and A. H. Guenther (AFSC, Kirtland AFB, N. Mex.) *In its* Opt. Phenomena in Liquid and Gaseous Media [1965] 15 p refs Prepared in Cooperation with AFSC, Kirtland AFB (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

A ruby laser induced breakdown experiment was performed with oxygen gas at a pressure of 5800 psi. The giant pulse, of about 0.5 joules with a pulse width of 10–15 nanoseconds, caused a breakdown most probably at the focus of the lens. The plasma or the shock wave initiated by the spark presumably spread to the ends of the pressure cell and ignited the neoprene gaskets. The plate glass windows of the cell were badly and deeply crazed on their inner surfaces. A pulse energy of 0.9 joules was measured on the oscilloscope with a half intensity width of about 10 nanoseconds. The fringes appeared to be about 1/3 order wide and showed no resolution of either the Brillouin doublet or the mode structure. The pulse probably contained a single mode and the breadth of the fringes resulted from the stimulated Brillouin effect. As the laser and gas cell were separated by 2 ft, the minimum time between the initial and stimulated laser pulse was 4 nanoseconds. The laser pulse width must have been smaller than the 10 nanoseconds indicated by the oscilloscope. The breakdown was estimated to have occurred at around 75 megawatts. The spectrograph showed that the laser light did not pass through the cell since only an intense continuum was observed. R.N.A.

N66-35539# New York Univ., N. Y. Dept. of Meteorology and Oceanography.
OPTICAL SOUNDING II. PART I: WATER VAPOR STUDIES UTILIZING A THERMALLY TUNED RUBY LASER RADAR
S. M. Schotland, J. Bradley, and A. Nathan Jun. 1966 24 p refs
(Contract DA-36-039-AMC-03411(E))
(TR-66-9; ECOM-03411-F; AD-635301) CFSTI: HC $1.00/MF $0.50

Experimental studies have been conducted utilizing a thermally tuned ruby laser radar to study the vertical profile of water vapor systems. Examples of thermal scans of the 6942.16A and 6942.38A water vapor lines are presented. Equipment has been assembled to study at high resolution (.02/cm) the line shape and strength of these lines. An engineering computation has been made of the temperature distribution within the ruby rod resulting from the energy absorbed from the pumping lamp. Author (TAB)

N66-35622# Springfield Armory, Mass.
DOUBLE PULSE PUMPING OF RUBY LASERS
Peter Shajenko 8 Apr. 1966 58 p refs
(SA-TR20-9301; AD-635065) CFSTI: HC $3.00/MF $0.50

Laser performance in double pulse mode of pumping was studied. The xenon flash lamp was energized by two condenser banks discharged in sequence with a time delay between both discharges. Theoretical analysis of discharge characteristics and of experimental data including discharge current, pumping light and laser output at threshold, and higher energy levels in relation to varying time delay are presented. Improvements in overall laser efficiency as much as 12% in double pulse pumping were obtained as compared with conventional single pulse pumping in the experimental setup. The possibility of adjusting the dynamic impedance of the light source and of modifying pumping light pulse for improvement of laser performance is cited. Author (TAB)

N66-35687*# National Aeronautics and Space Administration, Washington, D. C.
LASERS AND MASERS—A CONTINUING BIBLIOGRAPHY WITH INDEXES, FEBRUARY–APRIL 1966
Jul. 1966 465 p refs
(NASA-SP-7009(01)) CFSTI: HC $2.50/MF $2.50 CSCL 20E

Abstracts of reports and articles which appeared during the period February, 1965–April, 1966, in "Scientific and Technical Aerospace Reports", "International Aerospace Abstracts", and "Aerospace Medicine and Biology" are presented. Special attention is given to laser and maser applications as they relate to ranging and communications systems, astronomy and optics, and metalworking. A subject index and a personal author index are included. N.E.N.

N66-36239# Philco Corp., Blue Bell, Pa. Applied Research Lab.
STUDY OF LOSS MECHANISMS AND STIMULATED RAMAN EMISSION Final Technical Report, 1 May–31 Dec. 1965
C. C. Wang Mar. 1966 48 p refs
(Contract Nonr-4850(00); ARPA Order 306; Proj. Defender)
(A056-F; AD-632022) CFSTI: HC $2.00/MF $0.50

Extensive measurements were taken on the conversion efficiency and threshold of stimulated raman emission in benzene, nitrobenzene, toluene, and carbon disulfide. It was shown that the self-focusing action of a laser beam is responsible for the onset of stimulated raman emission.
Author (TAB)

N66-36248# Texas Univ., Austin. Antennas and Propagation Lab.
A GIANT-PULSE LASER FOR USE IN AN OPTICAL RADAR SYSTEM
Kenneth R. Hessel and Alfred H. La Grone 5 Aug. 1966 56 p refs
(Grant NSF GE-4775)
(NSF-P-9)

It has recently become possible to build lasers which, when operating in the giant pulse mode, have power outputs in the megawatt range. If operated at a fast pulse rate a giant pulse laser can be used effectively as a transmitter for an optical radar system. Because of the extremely small laser beamwidth and short wavelength the operating characteristics of an optical radar are different from a conventional radar. The laser system considered in this thesis consists in part of a ruby rod in an elliptical cylinder cavity. A xenon flashtube is used to illuminate the ruby. The flashtube and ruby are water cooled and plans are to operate the laser at a pulse rate of one pulse per second. A pulse forming line is used with the flashtube power supply so the current through the flashtube, and therefore the illumination of the ruby rod, is constant over the duration of the flash. A Kerr cell system is used to Q-switch the laser. Author

N66-36261*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SENSING OF METEOROLOGICAL VARIABLES BY LASER PROBE Semiannual Report, 1 Feb.–31 Jul. 1966
G. Fiocco 1 Aug. 1966 8 p
(Grants NGR-22-009-131; NGR-22-009-114)
(NASA-CR-77909) CFSTI: HC $1.00/MF $0.50 CSCL 20E

Computer analysis of aerosol density data, obtained by optical radar for heights between 10 km and 30 km, confirmed the existence of a broad aerosol maximum at a height of about 16 km over the North American continent. Correlation of aerosol content fluctuations with various meteorological quantities supported the contention that ozone was rapidly destroyed in the presence of large dust amounts. A preliminary analysis on the problem of determining atmospheric kinetic parameters from the scattering of laser light showed that a transmitted power of 6×10^5 watts in a single mode is necessary for an atmospheric probe. Several He–Ne and argon lasers were constructed and are being tested, and a ruby laser was modified for single-mode operation. Also reported are current measurements of the upper atmosphere by optical radar in Norway. G.G.

N66-36291# Lockheed Missiles and Space Co., Palo Alto, Calif.
SEMICONDUCTOR GALLIUM ARSENIDE LASER WITH A FLAT RESONATOR
N. G. Basov, O. V. Bogdankevich, V. A. Goncharov, B. M. Lavrushin, and V. Iu. Sudzilovskii [1966] 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 168, no. 6, 1966 p 1283–1286

Total generation power of optical radiation in a semiconductor laser is discussed in relation to a system with a flat cavity. The experimental setup, consisting of an n-type GaAs sample, is illustrated. Spectral distribution of the intensity of spontaneous and forced radiation of GaAs at 300° K is presented. To determine the losses in the inactive domain and to estimate the maximum gain coefficient at the generation wavelength, the transmission spectra of a GaAs plate in the same geometry as in the generation regime were measured. The dependence of the absorption coefficient on the wavelength obtained from an analysis of the transmission spectra is presented. Estimates of the minimum gain required for generation exceeded by almost an order of magnitude of the value of the absorption coefficient at the generation wavelength. It is stated that this contradiction may be associated with contraction of the forbidden band of the excited crystal. S.P.

N66-36387*# Varian Associates, Beverly, Mass. Quantum Electronics Div.

RESEARCH LEADING TO PRACTICAL RUBIDIUM MASER OSCILLATORS Final Report

8 Mar. 1966 17 p

(Contract NAS5-9607)

(NASA-CR-77924) CFSTI: HC $1.00/MF $0.50 CSCL 20E

It is reported that a laboratory which is equipped with two cell filling systems was set up and deals with problems related to optical pumping in rubidium. A theory describing the operation of the rubidium maser and the conditions for oscillation is summarized, and gives approximately the behavior of the maser as a function of light intensity and rubidium density. This theory shows that a limited exists in the power available out of the maser due to non-uniform illumination of the maser cell. Experimentally, a maser was built using the cell type approach and construction of a second maser was initiated. C.T.C.

N66-36423*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

RESEARCH IN SUPER POWER LASERS AND INTENSE MAGNETIC FIELDS

R. J. Schwinghamer *In its* Mfg. Res. at MSFC 1965 p 21-30 (See N66-36420 21-34) CFSTI: HC $2.00/MF $0.50

Superpower lasers were investigated for use in drilling and welding procedures. After pink and red ruby and glass lasers were studied, it was concluded that the most promising was the pink laser in a coaxial gun with aCassegainian focusing system, an input power of 240,000 J, and an output power of 2000 J. It has a high thermal conductivity; its emission wavelength is suitable for welding as it is characterized by less reflection and more absorption; life of the crystal still is better because it does not craze or solarize easily; and the unfocused beam spread is very small. Research developments in application of intense transient magnetic fields to various manufacturing problems are also reported. An electromagnetic constriction technique, employing high intensity pulsed fields, was used to correct oversized metal tunnels (e.g., Saturn V LOX). Pneumatically clamped and hand-held magnetomotive hammers were developed to remove weld distortions from Saturn V heavy skin sections, gore segments, and bulkheads. Progress on other magnetic field tools for manufacturing processes such as fastening, swaging, blanking, sizing and coining is also reported. L.E.W.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-36358# Royal Aircraft Establishment, Farnborough (England).

THE PROTECTION OF TANTALUM FROM OXIDATION AT HIGH TEMPERATURES WITH ALUMINUM-50% TIN COATINGS

R. Moreton Jan. 1966 21 p refs CFSTI: HC $4.00/MF $0.50 (RAE-TR-66017; AD-634909)

An Al-Sn coating was investigated as a protection against oxidation of tantalum sheet—a possible material for the combustion chambers of ramjets of hypersonic aircraft. Coatings containing equal parts by weight of Al and Sn were deposited from acetone slurries of the two metals and made impermeable by heating in vacuum for 1/2 hr at 1050° C. The coatings which then consisted of $TaAl_3$ covered with Al-Sn alloy, were assessed by oxidation tests, measurements of substrate hardening and mechanical tests. Tantalum was protected for up to 37-1/2 hr at 1500° C and 3-1/3 hr at 1600° C in air. Some self-healing occurred due to oxidation of molten Al-Sn alloy at defects in the outer oxide layer. Substrate hardening due to nitrogen penetration occurred in test-pieces where no signs of failure had been seen after heating in air at 1500° C. Tensile tests however showed that coated tantalum could be heated in air at 1500° C for up to 8 hr without loss of ductility at room temperature. Author (TAB)

N66-36504# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW CAPABILITIES OF SPECTRAL ANALYSIS OF METALS AND ALLOYS WITH THE USE OF PRELIMINARY BATCHING BY CONTACT SPARK DISCHARGE

K. V. Gudkova, K. I. Taganov, and Z. I. Shlepkova 20 Jan. 1966 12 p refs Transl. into ENGLISH from Tr. po Khim. i Khim. Tekhnol. Gor'kiy (USSR), no. 1, 1963 p 26-30 (FTD-TT-65-1483; TT-66-61487; AD-634813) CFSTI: HC $1.00/MF $0.50

Photoelectric recording of the spectrum of small batching of substance has an advantage over photographic recording not only in the part of a significant shortening of the time of measurement of the spectral lines but in relationship to a significant increase in sensitivity. Thus, for example when working with samples containing sulphur for development on the spectrograph ISP-22 with glass optics of the sulphur line 5320.6 A it was necessary that each spectrum be obtained from six support electrodes with the products of transfer-6-fold exposure was carried out for each spectrum; on the vacuum polychrometer one electrode was sufficient for the measurement of sulphur line intensity. This, small doses produced by contact-spark transfer a substance may be successfully measured during photoelectric recording of the spectrum on an ordinary apparatus both for analytic purposes and when solving problems of a research nature. Author (TAB)

N66-36567*# Battelle Memorial Inst., Columbus, Ohio.

WELDING-BASE METAL INVESTIGATION

D. L. Cheever, P. A. Kammer, R. E. Monroe, and D. C. Martin *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 3-36 refs (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75

(Contract NAS8-11445)

The effects of factors associated with aluminum base plate and filler wire on the occurrence of weld defects are investigated. Four factors that determine the weld defect potential of a material were considered: chemical content, which was used to describe all the intentional alloy additions specified as ranges; internal impurities, which were those elements limited by specifications to a maximum level; the hydrogen content determined by vacuum fusion analysis; and external impurities controlled by moisture additions to the weld shielding gas. Welds were examined by radiographic and sectioning techniques. The occurrence of pores, which were the only weld defects observed, was related to variations of each of the four factors between a high and a low level. The external impurities factor was the strongest factor followed in strength by the chemical content, internal impurities, and hydrogen content. The porosity level of the welds increased with increasing hydrogen content of the experimental base plate. S.P.

N66-36570*# Martin Co., Denver, Colo.

EFFECTS OF POROSITY ON MECHANICAL PROPERTIES OF 2014-T6 AND 2219-T87 ALUMINUM WELDS

John F. Rudy *In* NASA. Marshall Space Flight Center Aluminum Weld Develop. Complex Conf. 19 Jan. 1966 p 107–120 (See N66-35566 21-15) CFSTI: HC $4.25/MF $1.75 (Contract NAS8-11335)

To establish improved weld acceptance criteria, the relationship between the mechanical properties of a weld and porosity within the weld were studied. The method for obtaining the data to meet this objective is described. It requires the production of a statistically significant number of defective welds, the classification of these defects according to a system which has utility as a nondestructive tool in actual production welds, and the measurement of the mechanical properties of the classified welds. The status of the program is given and the data obtained are provided. H.S.W.

N66-35575# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE EFFECTS OF THERMAL TREATMENTS ON THE MATERIAL DAMPING AND FATIGUE PROPERTIES OF 2024 ALUMINUM ALLOY

Charles E. Archie (M.S. Thesis) Mar. 1966 84 p refs (GAM/MECH/66A-2; AD-635381) CFSTI: HC $3.00/MF $075

A comparison is made of the fatigue life and internal damping of 2024 aluminum alloy, naturally aged and artificially aged. The naturally aged alloy exhibited the higher damping and longer fatigue life when tested at resonant conditions. The naturally aged materials showed longer fatigue life at stresses above 16300 psi when tested in reverse bending. The only significant metallurgical difference observed was the increased vacancy concentration in the naturally aged alloy. Resonant fatigue tests conducted in vacuum environments resulted in greatly increased fatigue lives, compared with ambient conditions. It is postulated that moisture accelerates crack propagation in fatigue failures. Author (TAB)

N66-35583# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 312

28 Apr. 1966 35 p refs Transl. into ENGLISH from Chinese periodicals

(JPRS-35228; TT-66-31665) CFSTI: $2.00

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2. THE ORIENTATIONS OF NiO EPITAXIALLY GROWN ON Ni FILMS P. Hsu, C.-t. Ch'en, and K.-h. Kuo p 19–32 refs (See N66-35585 21-17)

N66-35584# Joint Publications Research Service, Washington, D. C.

SOME INVESTIGATIONS ON TITANIUM-CONTAINING AND HIGHER COBALT CONTENT ALNICO PERMANENT MAGNET ALLOY

Hsun-i Tseng, Ch'ang-hua Cheng, Yao-hsien fu, and Shao-po Wang *In its* Transl. on Communist China's Sci. and Technol. 28 Apr. 1966 p 1–18 refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 10, Oct. 1964 p 1027–1036 Presented at the Natl. Magnetism and Magnet Mater. Conv., Wu-hsieh, China, Apr. 1963 (See N66-35583 21-17) CFSTI: $2.00

Some investigations on the titanium-containing (≈5% Ti) and higher (≈34% Co) permanent magnet alloy recently developed upon the basis of the composition of Alnico-5 are reported. It is shown that superior permanent magnetic properties may be obtained by means of isothermal magnetic treatment as compared with those obtained by the controlled cooling rate treatment. It has been found that the coercive force is very sensitive to the temperature of isothermal magnetic treatment. The results indicate that different conditions of prior isothermal magnetic treatment lead to a state of different dispersion and morphology of the α'-phase, and hence to different permanent magnetic properties. The experimentally determined C-curve of the γ_1-phase shows that the precipitation of the γ_1-phase is very rapid. Careful metallographic examination has revealed that the so-called α_γ-phase is actually heteogeneous. The experimentally established quantitative relationship between the permanent magnet properties of the alloy and the content of the "α_γ-phase" clearly demonstrated the detrimental effect of the latter on the former. Author

N66-35585# Joint Publications Research Service, Washington, D. C.

THE ORIENTATION OF NiO EPITAXIALLY GROWN ON NI FILMS

P'u Hsu, Ch'ien-t'i Ch'en, and K'o-hsin Kuo *In its* Transl. on Communist China's Sci. and Technol. 28 Apr. 1966 p 19–32 refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 5, May 1965 p 989–996 (See N66-35583 21-17) CFSTI: $2.00

The orientations of NiO formed on evaporated Ni single-crystal films with surfaces parallel to (110), (001), or (111) have been studied by means of electron diffraction. Besides that, the parallel orientation relationship already known to exist between NiO and Ni has been confirmed. It was shown that <110> NiO// <110>Ni is common to all orientation relationships between NiO and Ni, thus making it clear that the close-packed direftion <110> plays an important role in the epitaxial growth of f.c.c. crystals. The various trends of epitaxial growth of NiO are discussed with respect to the number of <110> directions on the film surface and to the degree of perfection of Ni films. Author

N66-35646*# Atomics International, Canoga Park, Calif.

SOLUBILITY OF REFRACTORY METALS AND ALLOYS IN ALKALI METALS First Quarterly Report, Mar. 3–May 28, 1966

R. L. Mc Kisson and R. L. Eichelberger 18 Jul. 1966 25 p refs

(Contract NAS3-8507)

(NASA-CR-54993; AI-66-115) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Purpose of the study was to investigate solubilities of refractory metals and alloys in liquid alkali metals and to develop data for formulation of corrosion resistant alloys required for systems employing alkali metal coolants. The solution behavior of gettered alloys in highly purified potassium was observed in order to determine the effect of oxygen on solubility. The alloys, the solute materials, and the high temperature furnace required for further verifications are described. Test welds of T-111 to Cb-1Zr and of Cb-1Zr to Mo-1/2Ti were successfully made. The experimental system, consisting of five sequence-connected stainless steel vacuum chambers, each with its own pumping system and separated by vacuum gate valves, is briefly described. K.W.

N66-35680# Portugal. Nuclear Energy Commission, Sacavem. Div. of Chemistry and Metallurgy.

THE PHASE EQUILIBRIA IN URANIUM-COBALT-IRON ALLOYS IN THE PARTIAL RANGE U-U$_3$Co$_2$-UFe$_2$ [EQUILIBRIO DE XASES NO SECTOR URANIO-UCo$_2$-UFe$_2$ DO SISTEMA URANIO-COBALTO-FERRO]

Guenter Petzow (Mas-Plank-Inst. fuer Metallforsch.), and A. Oliveira Sampaio 1965 27 p refs Transl. into PORTUGUESE from Z. Erzbergbau Metallhuettenn. (Stuttgart), v. 58, no. 1, 1965 p 14–20
(LFEN.39(α, δ)) CFSTI: HC $2.00/MF $0.50

The system U–UCo_2–UFe_2 was investigated using metallographic, thermal, dilatommetric, chemical, and X-ray methods. Isothermal sections at 750° and 700°C and four temperature–concentration sections were worked and present a good survey of the phase spaces. A nonvariant 4-phase equilibrium was found at 730°C. The U_6Co and U_6Fe, and UCo_2 and UFe_2, respectively, exhibit complete solid solubility. The solubility of ternary additions in UCo and α-U is practically nil, and in β-U and γ-U it is very small. Author

N66-35688*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report No. 5, 15 Apr.–15 Jul. 1966
R. W. Harrison, ed. 29 Jul. 1966 31 p refs
(Contract NAS3-6474)
(NASA-CR-72057) CFSTI: HC $2.00/MF $0.50 CSCL 18J

Continuing research in fabricating advanced refractory alloys is reported. Samples of T-111 alloy base tubes were annealed for one hour at temperatures between 2500° and 3000°F in vacuum. They were examined by metallographic and microhardness techniques, and the data is tabulated. Recrystallation occurred in all specimens. Chemical analyses and mechanical properties of Mo–TZC alloy, and extrusion parameters of Cb-132M alloy billets are presented. Modification of the sodium transfer system for the prototype corrosion loop and a spectrographic analysis of hot trapped lithium for oxygen content are reported. N.E.N.

N66-35692# Air Force Systems Command, Wright-Patterson AFB, Ohio.
INVESTIGATION OF THE OPTICAL AND MAGNETO-OPTICAL PROPERTIES OF THIN FILMS OF (SE)CO_5 ALLOYS IN HIGH VACUUM [EINE UNTERSUCHUNG DES OPTISCHEN UND MAGNETOOPTISCHEN VERHALTENS DUENNER SCHICHTEN VON (SE)CO_5-LEGIERUNGEN IM HOCHVAKUUM]
Axel M. Stoffel (Ph.D. Thesis) Jan. 1965 156 p refs In GERMAN
CFSTI: HC $5.00/MF $1.00

Optical and magneto-optical constants of the alloy films were studied for the purpose of improving manufacturing conditions. The films were produced in high vacuum to prevent surface oxidation. The theoretical aspects of the study are discussed, particularly the presentation of the polarization condition by means of the Poincare sphere. All processes affecting the polarization of light are analyzed, and equations for the optical and magneto-optical constants are stated. The apparatus for measuring polarization changes is described. Measurements are given for films of Co, YCo_5, $SmCo_5$, $GdCo_5$, and $NdCo_5$. Highest values for the magneto-optical constants were obtained with a pure $SmCo_5$ film; in the red spectral range they equaled the highest known values. It was observed that the Kerr effect, especially the ellipticity, of almost all films increased after oxidation. Transl. by K.W.

N66-35694# United Kingdom Atomic Energy Authority, Springfields (England).
THE RELATION OF PROOF TESTING TO LONG-TERM CORROSION BEHAVIOR OF ZIRCONIUM ALLOYS
P. L. Allen, D. A. Moore, and F. W. Trowse 12 May 1966 43 p refs
(TRG-1134(S)) CFSTI: HC $2.00/MF $0.50

The results of proof tests performed in various ways are reported, and correlated with subsequent long-term corrosion behavior and with the heat treatment and microstructure of the alloys. The operational procedure over the start-up period of the proof test, during which the first 2000 Å thick layer of oxide forms, influences oxidation and hydrogen uptake both during this proof test and throughout the subsequent pretransition period of corrosion. With Zircaloy-2 having satisfactory corrosion behavior, hydrogen uptake over this pretransition period can be varied by a ratio of 3:1 by appropriate choice of start-up conditions for a proof test in steam at 400°C, 1500 lb/in^{2}g. Unsatisfactory distribution of intermetallic precipitates in Zircaloy-2 is detected by proof testing at 100 lb/in^{2}g., but not at 1500 lb/in^{2}g. A difference in behavior for a given material, depending on whether it is tested in the form of fuel tubing or of flat plates, is reported. Author

N66-35700# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
STATISTICAL TECHNIQUES AND ANALYSIS IN CORROSION MEASUREMENTS OF Zr ALLOYS IN TERPHENYLS
G. C. Impariso and M. Cocchi Jun. 1966 22 p refs
(EUR-2997.e) CFSTI: HC $1.00/MF $0.50

The scope of this paper is to describe the theoretical criteria and the experimental procedures adopted to investigate the agents that cause corrosion of Zr alloys in terphenyls; this work represents a first approach to this, indeed complex, problem. Author

N66-35734# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
STUDY OF U-Pu-Fe ALLOYS (MASURCA CRITICAL EXPERIMENT) [ETUDES D'ALLIAGES U-Pu-Fe (EXPERIENCE CRITQUE MASURAC)]
Pierre Barthelemy and Rene Boucher Jul. 1965 48 p refs In FRENCH
(CEA-R-2792; EUR-2449.f) CFSTI: HC $2.00/MF $0.50

To improve fast neutron reactors, tests, particularly those on oxidation properties, were conducted to determine the minimum compatible iron content that could be added to uranium and plutonium combustion materials. Described are preparation of uranium–plutonium alloys, oxidation tests, dilatometric and flammability tests, stability, compatibility of the U-Pu-Fe alloy with stainless steel, chrome steel, and nickel. To find a nuclear fuel with a suitable coefficient of expansion, and a high uranium content, the following properties were studied: fusion and conversion temperatures, thermal conductivity, the density and heat of fusion, micrographic structure, electrical resistivity, modulus of elasticity, heat of fusion, and thermal cycling. The dilatometric study determined the temperature of conversion to the solid state, the temperature of initial fusion, and the coefficient of expansion. It was concluded that the behavior of a 74U–25Pu–1Fe alloy is excellent at thermal cycling between 50° and 400°C.
Transl. by R.U.

N66-35776*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report No. 1, 21 Apr.–21 Jul. 1966
J. Rexer and J. M. Criscione 10 Aug. 1966 14 p refs
(Contract NASw-1405)
(NASA-CR-77634) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Continued research conducted under a program designed to develop procedures for applying protective coatings of iridium on refractory metals, and to study the rates of interdiffusion

of iridium with the refractory metals, tungsten, molybdenum, and niobium; is reported. A modification of the previously used electrolytic cell design was constructed to overcome difficulties encountered in trying to consistently electrodeposit iridium. The present design includes a sealed unit to eliminate atmospheric contamination of both the hot substrate metal and the molten slats. Preliminary tests indicate that the new cell operates well and that only minor equipment modifications may be required. Two sheets of molybdenum were coated with iridium. The coating in one of the samples had a defect and will be examined metallographically. Those samples having coherent coatings will be used in either oxidation tests or interdiffusion studies. Preliminary equipment modifications were made in an effort to adapt an induction heating apparatus for the study of the interdiffusion of iridium with tungsten, molybdenum, and niobium, respectively. Excellent temperature control between 100°C and 2000°C was obtained for a solid bar of tungsten. S.C.W.

N66-35857# Rensselaer Polytechnic Inst., Troy, N. Y. Corrosion Research Lab.

OXIDATION CHARACTERISTICS OF THE LANTHANIDE METALS

N. D. Greene and F. G. Hodge Mar. 1966 33 p refs
(Contract AT(30-1)-2714)
(RPI-2714-8) CFSTI: HC $2.00/MF $0.50

The oxidation rates and rate equations of 15 lanthanide metals including La and Y and excluding Pm, were determined in dry and moist air in the temperature range 100–800°C by precision weight gain measurements. Oxide structures were examined by both metallographic and X-ray analyses. The observed oxidation characteristics were found to be related to oxide structures and the physico-chemical properties of the rare earth metals. Author (NSA)

N66-35874*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

THE EFFECT OF HYDROGEN AND TEMPERATURE ON MECHANICAL PROPERTIES OF THE Ti-5Al-2.5Sn ELI ALLOY

R. A. Nadler Sep. 1965 35 p refs
(Contract SNP-1)
(NASA-CR-77890; WANL-TME-1287) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The effects of hydrogen content on the mechanical properties of the Ti-5Al-2.5Sn ELI alloy were investigated in the temperature range −320 to +200°F. In addition, the absorption of hydrogen by the alloy was studied to determine safe operating limits for the 0.020-inch thick core band. The data show that Ti-5Al-2.5Sn ELI can tolerate 300 ppM hydrogen at all temperatures investigated. It was established that the core band can safely be heated in hydrogen to 750°F for 3 hours and to 650°F for at least 5 hours during decay heating in NERVA reactors. The effects of pressure and radiation on the absorption of hydrogen during reactor operation were judged to be negligible. Author (NSA)

N66-35875*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

PROPERTIES OF P-03 GRAPHITE

V. Kachur 12 Jan. 1965 82 p refs
(Contract SNP-1)
(NASA-CR-77891; WANL-TME-1031) CFSTI: HC $3.00/MF $0.75 CSCL 18J

P-03 graphite, a premium fine-grained material, was evaluated for NERVA reactor hardware. This grade is available both as regularly molded stock with a well-established fabrication technology and as semicommercial isostatically molded stock. Both versions of P-03 have a high and relatively uniform density in the 1.85±0.03 g/cc range. The mechanical properties, are very promising for structural applications. Youngs modulus is in the $1.5–2\times10^6$ psi range. The thermal expansion coefficient, averaged between room temperature and 800°C, is between 2.3 and 3.3 microinches per inch per °F; for all types of P-03 at higher temperatures the coefficient increases to a somewhat greater value. Electrical resistivity was also determined; it shows good correlation with flexure strength. P-03 has a fine grained microstructure; the pores between coke particles are small in comparison with those of most other premium graphites. The large-scale structure is essentially free of such defects as cracks, voids, and inclusions. Author (NSA)

N66-35877# California Univ., Berkeley. Lawrence Radiation Lab.

DISLOCATION DIPOLES IN DEFORMED MAGNESIUM OXIDE

Thomas Robert Cass Nov. 1965 142 p refs
(Contract W-7405-ENG-48)
(UCRL-11996) CFSTI: HC $4.00/MF $1.00

The microscopic processes connected with the plastic deformation of magnesium oxide were investigated by a careful study of the dislocation substructures developed during deformation. However, the application of transmission electron microscopy, the experimental technique used, was limited because no complete theory of the diffraction contrast of dislocation dipoles was available. Thus, calculations of dislocation dipole contrast were made using the Dynamical Theory of Howie and Whelan. Besides this primary application of the computations the following auxiliary topics were treated: The transition from kinematical to dynamical diffraction conditions, differentiation between a narrow dipole and a single dislocation, determination of the nature, i.e., interstitial or vacancy, of the dipole, and determination of which surface a line defect lies closer to. In order to best utilize the results of the calculations, all experimental conditions were standardized. In particular, specimens were prepared from platelets diamond-sawed parallel to an active [110] slip plane, and observations were always made when only the [220] family of planes was responsible for the diffraction. Author (NSA)

N66-35879# Compagnie des Ateliers et Forges de la Loire, Paris (France). Dept. des Recherches.

[MECHANICAL PROPERTIES OF STEELS] Quarterly Report No. 5, Oct.–Dec. 1965

[1966] 64 p
(Contract EURATOM-033-64-9TEE-F(RD))
(EUR-2807; EURAEC-1578) CFSTI: HC $3.00/MF $0.75

Results of the continued stress corrosion testing of austenitic and austeno-ferritic stainless steels in various chloride solutions are reported. Observations made to date on the effects of the pH of the solution, silicon and molybdenum content of the steels, and the austeno-ferritic structure on the stress corrosion of steels are summarized. NSA

N66-35893# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

THERMAL EXPANSION AND TEMPERATURE DEPENDENCE OF ELASTIC MODULI OF POLYCRYSTALLINE HAFNIUM

D. F. Washburn and F. K. Blenchinger 15 Apr. 1966 17 p refs
(Contract W-31-109-ENG-52)
(KAPL-3112) CFSTI: HC $2.00/MF $0.50

Hafnium plate with a known texture was utilized for making measurements of the temperature dependence of the elastic moduli and for measuring the thermal expansion. The

texture of the plate was moderately strong with the basal planes parallel to the rolling direction and the basal poles tilted at an angle of about 45° to the rolling plane. The [1120] was aligned in the rolling direction. Author (NSA)

N66-35894# MSA Research Corp., Evans City, Pa.
RESULTS OF MECHANICAL PROPERTIES TESTS OF 316 SS SPECIMENS IN 1200 F SODIUM CONTAMINATED WITH OXYGEN (≈ 300 ppM) Topical Report No. 5
R. C. Andrews, R. H. Hiltz, L. H. Kirschler, S. J. Rodgers, and F. Tepper May 1966 116 p refs
(Contract AT(11-1)-765)
(MSAR-66-78) CFSTI: HC $4.00/MF $0.75

The mechanical properties of one heat of type 316 stainless steel were measured in a dynamic sodium system contaminated with 300 ppM oxygen at 1200°F. The effects were evaluated by comparing these mechanical properties with the mechanical properties of the same heat in air, helium and low oxygen sodium. Some comparisons were also made with regard to a carburizing environment. Both as received and 4000-hour exposed material were tested. Creep, creep-rupture, and fatigue tests were conducted in the flowing sodium system, while tensile tests were conducted in air and helium at both room temperature and test temperature on exposed material. Impact tests were conducted in air at room temperature. Metallurgical techniques used in post-test evaluation of the specimens and tabs included carbon analyses, microhardness measurements, microprobe analyses, metallographic analyses, and standard X-ray diffraction. Sodium chemistry, cold trapping, and plugging indicator studies are discussed, as well as operation and post-test examination. Author (NSA)

N66-35898# Bettis Atomic Power Lab., West Mifflin, Pa.
SOME OBSERVATIONS ON ZIRCONIUM AND ITS ALLOYS BY TRANSMISSION ELECTRON MICROSCOPY
O. M. Katz Apr. 1966 64 p refs Presented at the 23d Electron Microscopy Soc. Ann. Meeting, New York, Aug. 1965
(Contract AT(11-1)-GEN-14)
(WAPD-T-1819; CONF-650814-2) CFSTI: HC $3.00/MF $0.75

Structures obtained by cold-working Zr sheet and annealing Zircaloy-4 tubes are discussed. The most prominent slip mode is $\{10\bar{1}0\}\langle 11\bar{2}0\rangle$ even though some evidence of slip on $\{10\bar{1}1\}$ was found. Twinning on the $\{10\bar{1}2\}$ planes was observed. In the first stages of cold working, a subgrain boundary network is formed where the density of dislocations in the boundaries increases. For heavily worked material, the dislocations form dense tangled bands which in some areas form a cell structure. In Zircaloy-4 the intermetallic precipitates anchor the dislocations, increasing the strength. Upon recovery, there is a sharpening of subgrain boundaries and dislocation walls, and some reorientation seems to have started. Author (NSA)

N66-35982*# West Virginia Univ., Morgantown.
PRODUCTION OF DISPERSION ALLOYS WITH THE AID OF ULTRASONICS Final Report
Harold V. Fairbanks Jun. 1966 15 p refs
(Grant NsG-533)
(NASA-CR-77778) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The results are summarized from research on the dispersion of inerts in a molten matrix by ultrasonic energy, and the ultrasonic treatment of alloys to produce dispersion strengthening. Mixing an inert material into molten aluminum indicated that a nearly uniform dispersion by the use of ultrasonics could be obtained. It is also reported that insonation during the solidification of gray cast iron produced more ferrite and less pearlite than the non-insonated reference specimen. Additional results are given and recommendations for further study are made. H.S.W.

N66-35984*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report No. 1, 21 Apr.–21 Jul. 1966
J. Rexer and J. M. Criscione [1966] 15 p refs
(Contract NASw-1405)
(NASA-CR-77771) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Progress is reported in research to develop procedures for applying protective coatings of iridium on refractory metals, and to study the rates of interdiffusion of iridium with tungsten, molybdenum, and niobium. A previously used electrolytic cell design was modified to overcome atmospheric contamination of both the hot substrate metal and the molten salts. Preliminary tests indicate that the new cell operates properly. In addition it is reported that molybdenum samples were coated with iridium and prepared for either oxidation tests or interdiffusion studies. H.S.W.

N66-36025# National Engineering Lab., Glasgow (Scotland).
SOME ASPECTS OF THE COLD EXTRUSION OF STEEL
Oct. 1965 91 p refs Presented at Inst. of Sheet Metal Eng., 3d Intern. Conf. on the Cold Extrusion of Steel, Eastbourne, Great Britain, 2–4 Nov. 1965
(NEL-196)

Basic research has been undertaken on several aspects of the cold extrusion of steel. Further attention has been given to the problem of predicting, from a knowledge of the properties of the billet, the pressure required to extrude rod. The effect of the billet length/diameter ratio, l_0/d_0 on the pressure required to extrude rods and cans has been ascertained over a range of conditions. The factors governing the simultaneous extrusion of axi-symmetric rod, tube, or can from one end, and any one of these from the other end of cylindrical billets have been established. The effect of restricting the flow of metal in either direction was also ascertained. A particular method of gathering material at any position along the length of a rod has been examined and the effect of the relevant factors ascertained. The application of the new process of hydrostatic extrusion to the cold extrusion of steel has been investigated. Typical advantages conferred by the process, such as the lowering of the extrusion pressure, the absence of the phosphate coating, extrusion of difficult materials, extrusion of long billets etc. have been indicated and likely developments outlined. Author

N66-36122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MONOTONIC MAGNETOSTRICTION FOR NONFERROMAGNETIC MATERIALS
Lawrence Flax Washington, NASA, Sep. 1966 15 p refs
(NASA-TN-D-3605) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The constant magnetostriction coefficient for nonferromagnetic materials is derived in terms of changes in the Fermi surface. The theory is applied to Fermi surfaces of spherical and elliptical geometries. The magnetostriction coefficient along the trigonal axis of bismuth is calculated and compared with experimental results. Author

N66-36128*# Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS Final Report
A. Thiruvengadam and H. S. Preiser 29 Nov. 1965 79 p refs
(Contract NAS3-4172)
(NASA-CR-72035; TR-467) CFSTI: HC $3.00/MF $0.75 CSCL 11F

This report summarizes the results of investigations on the cavitation damage resistance, the high frequency fatigue and the stress corrosion behavior of five metals in liquid sodium up to 1500° F. The test duration is an important parameter in evaluating the relative cavitation damage resistance. Stellite 6B exhibits the greatest resistance as compared with Cb-132M, T-222, TZM and 316 stainless steel. The rate of damage decreases with increasing temperature. High frequency fatigue tests at ~35 ppm and at ~100 ppm oxide contamination in liquid sodium up to 1500°F show that the oxide content does not change the fatigue behavior of TZM and 316 stainless steel. The fatigue of 316 stainless steel in 1500°F sodium at 14,000 cps is comparable with the results obtained at 1500°F vacuum (3×10^{-5} torr) at 4–5 cps. No stress corrosion cracking was observed on TZM and on 316 stainless steel over a 60 hour test at two oxide levels (≈35 ppm and ≈100 ppm) in liquid sodium at 1000° F and 1500° F up to 100% yield. Author

N66-36138*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF CHROMIUM–IRON–MOLYBDENUM AND CHROMIUM–IRON–TUNGSTEN ALLOYS [ISSLEDOVANIYE SPLAVOV KHROM–ZHELEZO–MOLIBDEN I KHROM–ZHELEZO–VOL'FRAM]

R. A. Alfintseva, G. P. Dmitriyeva, V. G. Korobeynikova, V. M. Pan, V. N. Svechnikov et al Sep. 1966 30 p refs Transl. into ENGLISH from Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR (Kiev), no. 21, 1964 p 108–124

(NASA-TT-F-10285) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Phase diagrams were constructed for the Cr-Fe-Mo and Cr-Fe-W ternary systems containing up to 55% of iron and up to 30% of molybdenum or tungsten. Hardness and resistance to air oxidation at elevated temperatures were also determined for some of the alloys. Author

N66-36172# National Engineering Lab., Glasgow (Scotland).

COMPLEX-STRESS CREEP FRACTURE OF MAGNESIUM–2 PER CENT ALUMINIUM ALLOY AT 50°C

A. E. Johnson and B. Khan Oct. 1965 70 p refs

(NEL-198)

A study of the tertiary creep and creep fracture characteristics of magnesium–2 per cent aluminium alloy subjected to complex stressing at 50°C is reported. Pure tension, pure torsion, and combined tension and torsion creep tests of 40–3000 hours' duration were carried out, and data obtained are detailed and analyzed. Continuous cracking is shown to occur in tertiary creep, but is very limited and varies considerably; it is mainly intercrystalline, and the fractures are partly transcrystalline. The stress criterion of the time to fracture is the maximum principal stress. No specific relation between octahedral stress and onset of tertiary creep was found. At higher tension/shear stress ratios, tertiary creep at 50°C is anisotropic and is relatively much greater than at 20°C. It is possibly an anisotropic function of octahedral stress and a complex function of maximum principal stress. At lower stress levels, however, the latter function may be simplified. Author

N66-36185# Titanium Metals Corp. of America, West Caldwell, N. J. Techical Service Dept.

Ti–6Al–2Sn–4Zr–2Mo—A NEW HIGH TEMPERATURE ALLOY WITH AN OUTSTANDING COMBINATION OF PROPERTIES FOR SERVICE TO 1050°F

31 Jan. 1966 26 p

A super-alpha alloy optimized to provide an excellent combination of creep strength, ultimate tensile strength, toughness, and stability to 1050°F was produced. The Ti–6Al–2Sn–4Zr–2Mo alloy has a density of 0.164 lbs/in^3. The alloy development and forging programs are described. Test results are discussed and data is presented in tabular and graph form on tensile properties, pre-crack Charpy impact tests, mechanical properties at temperatures in the 100° – 1100°F range, creep stability, and salt stress corrosion. N.E.N.

N66-36188# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Quarterly Progress Report No. 10

H. H. Klepfer, J. L. Jaech, and R. E. Blood Oct. 1965 48 p refs

(Contract AT(04-3)-189)

(GEAP-4960; EURAEC-1538) CFSTI: HC $2.00/MF $0.50

Nonuniform distribution of coarse intermetallic compounds is detrimental to corrosion performance. Segregation and thus nonuniform intermetallic distribution result from processing in the two-phase alpha-plus-beta temperature region; this region was determined to be 800 to 900°C for the Zr–2 at.% Cr–0.16 at. % Fe alloy. Beta solution treatments of 6 hours at 1000° C or 1/3 to 1 1/4 hours at 1050° C were found to be required to take large, 4μ, precipitates into solution. Precipitate coarsening during alpha annealing at temperatures of 760°C and below was found to be very slow. These results and corrosion test results on the alloy fabricated in twenty-six different ways were employed in specifying a tentative fabrication schedule of a second batch of fuel cladding. Tests in progress in high pressure, refreshed steam (25 ppM O_2+ 3 ppM H_2) at 300, 400, and 500° C appear to show that up to 100 ppM, the nitrogen content of the alloy has no significant effect on corrosion. Author (NSA)

N66-36218# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF IMPURITIES AND RARE-EARTH ELEMENTS ON THE PROPERTIES OF ALLOYS

M. W. Pridantsev 16 Feb. 1966 231 p refs Transl. into English of the book "Vliyaniye Primesey i Redkozemel'nykh Elementov Na Svoystva Splavov" Moscow, Metallurgizdat., 1962 p 1–208

(FTD-MT-64-295; TT-66-61574; AD-634697) CFSTI: HC $6.00/MF $1.25

The translation considers the influence of certain fusible elements of impurities and additions of alkali earth and rare-earth elements on the technological, mechanical, and auxiliary properties of high alloy steels and alloys. Systematized data about properties of the indicated element impurities and mechanism of their influence are listed. Author (TAB)

N66-36234# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.

OXIDATION STUDIES OF TITANIUM BORONITRIDE IN AIR

Albert P. Levitt and Philip Wong Apr. 1966 17 p refs

(AMRA-TR-66-09; AD-633299) CFSTI: HC $1.00/MF $0.50

The oxidation characteristics of titanium boronitride formed by reactive hot pressing were determined over the temperature range 1010°C to 1425°C. An automatic recording balance was used to determine weight loss versus time at each test temperature for compositions containing 1.5 and 2 moles of excess boron nitride. It was found that (a) a parabolic rate law holds for oxidation of this material; (b) there was very little difference between the oxidation rates for the two compositions; and (c) the overall activation energy for the process was 28,000 calories per mole. X-ray diffraction analysis of the oxidized surface layer indicated that it was primarily composed of TiO_2. The presence of boron oxide was suggested but not positively identified. Possible oxidation reactions are presented and the mechanisms

are discussed. It was concluded that titanium boronitride cannot be used for sustained structural service in an oxidizing atmosphere above 1000°C. Author (TAB)

N66-36368*# Temple Univ., Philadelphia, Pa.
CONTAINMENT OF LIQUID ZIRCONIUM AND NIOBIUM CARBIDES ON GRAPHITE BETWEEN 3500° AND 4700°K
J. A. Cahill and A. V. Grosse Washington, NASA, Sep. 1966 42 p refs
(NASA Order C-54468A)
(NASA-CR-608) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Three niobium and two zirconium carbide liquid pipes approximately 4.5 cm long×3 cm. i.d.×0.5 cm wall were contained in rotating graphite crucibles at temperatures between 3800° and 4700°K for periods between 2 and 10 minutes. The heat source used was the rotating double arc furnace operated in a helium atmosphere. The increase in carbon content of the carbide pipes under the conditions of these tests and the recession (i.e., decrease in wall thickness of the graphite crucibles supporting the carbides) caused by the sublimation and solubility of the graphite were measured. Present results indicate the order of magnitude one can expect for this recession if pure graphite is used as a crucible or pipe material to contain the carbides is about 0.1 mm/min. or 6.0 mm/hr. Author

N66-36378# Boeing Scientific Research Labs., Seattle, Wash.
SOLID STATE PHYSICS LABORATORY-REVIEW, JANUARY–JUNE 1966
[1966] 157 p refs

This journal highlights some of the research in areas such as the physical and mechanical properties of titanium alloys, electron microscopy, fatigue of metals, ultrasonics, and Mossbauer effect. Brief summaries of the research projects conducted are provided. A cumulative bibliography of publications generated from this research is included. H.S.W.

N66-36379# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
OPTIMUM HARDNESS FOR MAXIMUM FATIGUE STRENGTH OF STEEL
J. F. Millan (Caterpillar Tractor Co.), Dean Morrow, and G. R. Halford May 1966 40 p refs Presented at Intern. Conf. on Fracture, Sendai, Japan, Sep. 1965
(T&AM-288; DI-13)

Observations relating to an optimum hardness for maximum fatigue strength of steels are reviewed. Data are presented to illustrate the influence of hardness on the mechanical behavior of SAE 1045 steel. Suggested causes for decreased strength and ductility at high hardness are discussed, and the idea is advanced that a transition from shear to tensile governed failure takes place as hardness increases. Resistance to shear stress is envisioned as increasing with hardness while the resistance to tensile stress decreases causing a sharp drop in ductility and strength. This view of the fatigue resistance of hard steels suggests ways to improve performance of hard steels permitting the full strength potential to be realized. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-36525# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
ENHANCED SURFACE LAYER DIFFUSION IN NON-METALLIC COMPOUNDS
Henry C. Graham and Norman M. Tallan Mar. 1966 29 p refs
(ARL-66-0058; AD-634558) CFSTI: HC $2.00/MF $0.50

The literature on the subject of enhanced surface layer diffusion in nonmetallic compounds is critically reviewed. It is concluded that the enhancement results from an increase in the pre-exponential factor and that the diffusion mechanism is the same in both the bulk material and in the subsurface layer. The space charge treatment of Lehovec is presented as the most fruitful source of a theoretical explanation, but it is also established that additional theoretical and experimental work must be undertaken to find the source of the observed increase in the pre-exponential factor of the diffusion coefficient. It is further concluded that, in general, dislocations do not contribute significantly to the enhanced diffusion in the subsurface layer. Possible practical applications of the enhancement phenomenon are also presented. Author (TAB)

N66-36545# Picatinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center.
CROSSLINKING, THERMAL AND MECHANICAL PROPERTIES OF THERMOPLASTIC AND PHENOLIC RESIN SYSTEMS A Bibliography
David W. Levi Feb. 1966 49 p refs
(PLASTEC-11; AD-634234) CFSTI: HC $2.00/MF $0.50

An annotated bibliography of 184 items is reported on the crosslinking, thermal and mechanical properties of thermoplastic and phenolic resin systems, it is limited to the references in the author's personal file. However, these cover the significant journals in the field, for the years 1960–1965. Complete subject and author indexes are included for the convenience of the user. Author (TAB)

N66-36586# Princeton Univ., N. J. Frick Chemical Lab.
THERMAL STABILITY OF ELASTOMERIC NETWORKS AT HIGH TEMPERATURES
T. C. P. Lee, L. H. Sperling, and A. V. Tobolsky Jun. 1966 17 p refs With addendum on SiB-2 properties
(Contract Nonr-1858(07))
(ONR-TR-RLT-93; AD-634804) CFSTI: HC $1.00/MF $0.50

Using a dry nitrogen atmosphere, stress relaxation experiments were carried out on poly(dimethyl siloxane) and an ethylene–propylene terpolymer. Relaxation times much longer than expected were observed, and plots of ln f(t)/f(0) vs time were linear in all cases. Author

N66-36934*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTS ON ADHESION OF FINE CERAMIC POWDERS IN ULTRA-HIGH VACUUM
Jonathan D. Klein and Guy V. Ferry *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 197–199 refs (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

In an effort to gain insight into the state of fine powders and the behavior of materials in a lunar environment, the adhesion of fine ceramic powders in ultrahigh vacuum is studied. A pan was fabricated and placed in a standard 20 cu ft vacuum chamber. The pan could be tilted about a horizontal axis to test the behavior of the powder, and could be vibrated from outside the vacuum. Results are reported for samples of garnet powder, alumina grinding powder, and pure alumina powder. The problem of measuring the degree of surface cleanliness and the extent of the outgassing arose

in these experiments. Subsequent samples were highly stressed glass drops (Rupert drops) made by dropping molten glass into water, thereby quenching in the thermal stresses. It was concluded that the adhesion of clean surfaces in ultrahigh vacuum is small and that adhesive forces, if present, are smaller than can be observed on the scale used. S.P.

N66-35983*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS Final Biennial Report, 1 May 1964–1 May 1966
E. E. Kerlin and E. T. Smith 1 Jul. 1966 520 p refs
(Contract NAS8-2450)
(NASA-CR-77772; FZK-290) CFSTI: HC $5.69/MF $2.75 CSCL 18J

A series of tests was conducted to measure the effects of the various combinations of nuclear radiation, vacuum, and cryotemperatures on nonmetallic engineering materials. The purpose of the tests was to evaluate materials for potential use in spacecraft containing nuclear reactors, where these reactors would be used either as a source of propulsion or for the generation of electrical power. Materials from the following classifications were evaluated: adhesives, seals, thermal insulations, dielectrics, lubricants, sealants, and thermal control coatings. The tests included measurements of lap-shear strength, ultimate tensile strength, ultimate elongation, stress-strain characteristics, weight loss, lubrication properties, compression strength, dissipation factor, dielectric strength, spectral reflectivity, thermal conductivity, and potted-wire pull-out strength. C.T.C.

N66-36002# Forest Products Lab., Madison, Wis.
EFFECT OF THERMAL CYCLING ON TENSILE AND COMPRESSIVE STRENGTH OF REINFORCED PLASTIC LAMINATES
Gordon H. Stevens Aug. 1965 15 p refs
(Contract AF 33(657)-63-358)
(FPL-37)

This paper presents the modulus of elasticity and strength values of four reinforced plastic laminates in tension and compression at room temperature and at 500°F. Prior to evaluation at these temperatures, the test specimens were exposed to thermal-shock cycling. Three of the laminates evaluated in this study were reinforced with 181-A1100 glass fabric and represented three resin systems: a phenolic resin (CTL 37-9X), an epoxy resin (ERSB-0111), and a phenyl-silane (Narmco 534). The fourth was a phenolic-asbestos laminate made of R/M Pyrotex felt style 41-RPD. In general, thermal-shock cycling had less effect on modulus of elasticity than on strength. Properties at room temperature tended to decrease after exposure to cycling, while the properties of most laminates evaluated at 500°F, were not seriously affected. Author

N66-36029# Tyco Labs., Inc., Waltham, Mass.
RESEARCH ON THE ELECTROCHEMICAL OXIDATION OF HEXANE AND ITS ISOMERS First Semiannual Interim Report, Nov. 16, 1965–May 15, 1966
S. B. Brummer [1966] 53 p refs
(Contract DA-44-009-AMC-1408(T))
(AD-634846) CFSTI: HC $3.00/MF $0.50

The chemical mechanism of the adsorption and oxidation of C_3H_8 and n-C_6H_{14} on smooth Pt electrodes from 12M H_3PO_4 at 130°C was characterization of the finally-adsorbed residues for C_3H_8 at 130°C; number of sites occupied by each adsorbed C_3H_8 molecule; role of adsorbed species in the over-all C_3H_8 to CO_2 reaction; measurement of n-hexane adsorbate; kinetics of n-hexane adsorption; steady-state n-hexane adsorption; present status of anodic hydrocarbon oxidation mechanism. TAB

N66-36061# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSFORMATION OF RUBBER
B. Dolgoplosk 17 Dec. 1965 10 p Transl. into ENGLISH from Izv. (Moscow), 17 Nov. 1964 p 7
(FTD-TT-65-1331; TT-65-64839; AD-625055) CFSTI: HC $1.00/MF $0.50

The report discusses the ways in which the problem of the synthesis of rubber is developing. TAB

N66-36121*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FRICTION CHARACTERISTICS OF SINGLE-CRYSTAL AND POLYCRYSTALLINE ALUMINUM OXIDE IN CONTACT WITH VARIOUS METALS IN VACUUM
Donald H. Buckley Washington, NASA, Sep. 1966 18 p refs
(NASA-TN-D-3593) CFSTI: HC $1.00/MF $0.50 CSCL 11B

An investigation was conducted in vacuum to gain a better understanding of the friction and adhesion concepts of the ceramic material aluminum oxide in its single-crystal and polycrystalline form in sliding contact with various metals. Experiments were conducted in a vacuum to 10^{-10} torr with surfaces that were outgassed. The specimens were a hemispherical or a spherical surface sliding on a rotating flat. The materials were studied at rotating speeds of 0.013 centimeter per second, loads to 1500 grams, and ambient temperatures to 575°C. The results of the investigation show that, with metals sliding on sapphire, stresses result in fracture within the sapphire. These fracture stresses determine the measured friction. When metals were slid on polycrystalline aluminum oxide, adhesion of the metal to the aluminum oxide resulted in shear in the metals. Coefficients of friction for most hexagonal metals sliding on aluminum oxide were lower than for cubic metals sliding on aluminum oxide. Adhesion of metal to aluminum oxide occurs in air as well as with clean surfaces in vacuum. Author

N66-36196# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.
GLASS-REINFORCED PLASTIC LAMINATES AND REINFORCING GLASS FIBERS AND FLAKES Bibliography
E. R. Adams, comp., Jul. 1965 83 p refs
(TIL/BIB/97)

References (289) are given to reports on glass-reinforced plastics, laminates of such reinforced plastics, and glass for reinforcement of plastics published from 1948 to 1965. Separate author and subject indexes are included. NSA

N66-36292# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE INFLUENCE OF ELEVATED TEMPERATURES ON THE DYNAMIC CHARACTERISTICS OF GLASS-PLASTICS
P. I. Galaka, A. A. Bondarenko, and A. I. Talalov [1966 8 p refs Transl. into ENGLISH from Energy Dissipation (Kiev), 1966 p 200–204

Some dynamic characteristics of glass plastics, with an epoxy resin base binder, were studied in the 300° to 600°K temperature range. To determine the effect of elevated temperatures on the values of natural transverse vibration frequencies, three batches of prismatic, cantilevered samples

were set into resonance by a special power exciter. Satisfactory agreement between the values of the relative frequencies, corresponding to the same value of the temperature, indicates that the value of the frequency ratio is independent of the geometric size of the samples and is a function only of the temperature. The elastic modulus was determined by a frequency method at various temperatures. A comparison of the curve of change in the elastic modulus with the thermochemical characteristic of the binder shows a sharp diminution in the elastic modulus starting with 320°K. The damping properties of glass plastics as a function of sample temperature are also assessed. Data show that the complex nature of this dependence indicates the existence of several energy dissipation mechanisms in the material. M.G.J.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-35385# Brown Univ., Providence, R. I.
ON THE CLAUSIUS-DUHEM INEQUALITY
Morton E. Gurtin and William O. Williams Mar. 1966 19 p refs
(Contract Nonr-562(40))
(TR-7; AD-635447) CFSTI: HC $1.00/MF $0.50

A method of axiomatically deriving a form of the second law of thermodynamics appropriate to continuum mechanics from a general statement of the law is discussed: such a procedure logically leads to the existence of two temperatures and a modified form of the Clausius-Duhem inequality. It is then shown that for a certain class of materials the inequality can hold only if the two temperatures are always the same and thus that for such materials the usual form of the Clausius-Duhem inequality is appropriate. Finally it is shown that a simple material with memory falls into this class of materials. Author (TAB)

N66-35505# Mitre Corp., Bedford, Mass.
NUMERICAL COMPARISON OF EXACT, UNIFORM, AND NON-UNIFORM ASYMPTOTIC SOLUTION OF THE REDUCED WAVE EQUATION NEAR A CAUSTIC
R. M. Lewis and L. J. Kaplan Jun. 1966 26 p refs
(Contract AF 19(628)-5165)
(MTR-32; ESD-TR-66-66; AD-635049) CFSTI: HC $1.00/MF $0.50

A numerical comparison of the exact solution, the uniform asymptotic solution, and the non-uniform asymptotic solution of a field that produces a circular caustic is performed. It is seen that the uniform asymptotic solution is accurate even at the caustic for moderate values of ka. Curves and data are given as a function of ka and distances from the caustic. The asymptotic expressions are derived both from the exact solution and from the physics of the circular caustic. Author (TAB)

N66-35543# Washington Univ., Seattle. Dept. of Mathematics.
THE NON-INVARIANCE OF HYPERBOLICITY IN PARTIAL DIFFERENTIAL EQUATIONS
H. H. Johnson Jun. 1966 22 p refs
(Contract Nonr-477(15))
(TR-30; AD-635099) CFSTI: HC $1.00/MF $0.50

Hyperbolicity is shown to be not an absolute invariant in the sense defined in. Specifically, an example of a non-hyperbolic system is given with a partial prolongation which is hyperbolic. A large class of systems is found which is closed under modified absolute equivalence and which contains all hyperbolic systems. These ideas are applied to give existence theorems for the initial value problem in several types of non-hyperbolic systems. Author (TAB)

N66-35556*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A SURVEY OF METHODS FOR GENERATING LIAPUNOV FUNCTIONS
C. C. Dearman and A. R. Le May *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 114–132 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

Liapunov's method consists of generating a function in the state variables which must possess certain properties. If this Liapunov function could be exhibited, certain conclusions could be made concerning the stability properties of the dynamical system. There are as yet no general schemes for constructing these functions, but there are methods for generating Liapunov functions for special cases of certain types and even for classes of certain dynamical systems. This survey describes those methods which, with possible extensions and modifications, appear to offer the best hope for applications to practical nonlinear dynamical systems. Author

N66-35557*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ORTHONORMALIZATION PROCEDURE FOR MULTIVARIABLE FUNCTION APPROXIMATION
Hugo Ingram *In its* Aero-Astrodyn. Res. Rev. No. 2 1 Apr. 1965 p 133–138 refs (See N66-35546 21-34) CFSTI: HC $5.00/MF $1.00

When a function of several variables is given numerically in tabular form, the orthonormalization technique allows an approximation of the numerical data to be determined in a convenient functional form. A method is described that requires much less computational work than the usual least squares technique, and allows the accuracy of the results to be more easily controlled. Author

N66-35626# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
REDUCIBILITY OF MATRIX POLYNOMIALS AND THEIR TRACES
John S. Lew Apr. 1966 12 p refs
(Contract Nonr-562(40))
(TR-10; AD-635446) CFSTI: HC $1.00/MF $0.50

For n x n matrices, we show the reducibility in degree of certain products of matrix variables and their traces, thus generalizing from two- and three-dimensional space some results used by Rivlin, Smith, and Spencer to get an orthogonal integrity basis for second-rank symmetric tensors. In particular we show the reducibility for $n > 3$ of any product of 2^n-1 matrices and of its trace. Author (TAB)

N66-35627# Carnegie Inst. of Tech., Pittsburgh, Pa. Center for the Study of Information Processing.
STUDIES CONCERNING MINIMAL TIME SOLUTIONS TO THE FIRING SQUAD SYNCHRONIZATION PROBLEM
Robert M. Balzer (Ph.D. Thesis) 1966 175 p refs Sponsored in part by NSF
(Contract ARPA SD-146)
(AD-635056) CFSTI: HC $1.50/MF $1.00

This paper presents a description of a general outline for a minimal time solution to the firing squad synchronization problem, and a solution of this form which is composed of machines with only eight states. The paper then discusses the verification of this minimal time solution by computer simulation, and gives a

mathematical induction proof that the solution works for any length. The paper then discusses some efforts to determine the minimal number of states needed for a minimal time solution. No four state minimal time solution exists. A reasonable set of conditions are presented for which no five state minimal time solutions exist. The final part of the paper demonstrates the equivalence of one-dimensional iterative arrays and turing machines, and shows how the techniques used here apply to problems of optimizing turing machines for a given computation. Author (TAB)

N66-35638# Texas A&M Univ., College Station.
SOLUTIONS OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS BY A LINEAR PROGRAMMING TECHNIQUE
James Franklin Ormand, Jr. (M.S. Thesis) May 1966 179 p refs
(Contract AF 33(608)-1284)
(AD-635247) CFSTI: HC $4.00/MF $1.00

The feasibility of finding numerical solutions of boundary value problems of partial and ordinary differential equations by use of a linear programming technique is demonstrated. This method considers as distinct variables the values of the unknowns and their derivatives at each grid point. Then the conditions set up by the differential equation and the boundary values are approximated by a variety of linear equations in these variables. Efforts are concentrated on experimenting with the weight factors used in the solution of Bessel's ordinary differential equation. By varying the number of different types of approximations, weight factors and/or the number of grid points, an attempt is made to select the most favorable conditions for solutions by these methods. Emphasis is placed on determining the minimum number of grid points for satisfactory results. Computer programs in Fortran IV are included for this method, which is restricted to the solution of linear differential equations and requires a large amount of core space in the computer. S.P.

N66-35707# California Univ., Berkeley. Operations Research Center.
THE DUALPLEX METHOD FOR LARGE-SCALE LINEAR PROGRAMS
Saul I. Gass Jun. 1966 105 p refs
(Contracts Nonr-222(83); DA-31-124-ARO(D)-331; Grant NsF GP-4593)
(ORC-66-15; AD-635497) CFSTI: HC $3.00/MF $0.75

In chapter II the author describes the dualplex algorithm as it applies to the general linear programming problem with the structure B = IW + AX + BY. The necessary proofs and formulas are given, along with a summary of the method and a numerical example. Chapter III describes how the algorithm would be applied to a 2-stage problem and then its extension to a general T-stage problem. A summary of the T-stage algorithm is given and a 2-stage numerical example is solved. Chapter IV represents specialization of the dualplex method to the bounded linear-programming problem, the generalized bounded problem, and the transportation problem and related systems, in each case, a new and efficient algorithm is developed. Author (TAB)

N66-35711# Ohio State Univ., Columbus.
THE ATTACHMENT OF CALCULUS TO ROOT PLANED SURFACES
Raymond Anthony Kopczyk (M.S. Thesis) 1966 28 p refs
(AD-635270) CFSTI: HC $1.50/MF $0.50

Sixteen teeth were root planed and allowed to remain in situ until new calculus deposits formed. The teeth were extracted and examined histologically to determine the mechanism by which calculus attaches to root surfaces. The major modes of attachment of calculus to root planed surfaces were by way of a cuticle-like structure and by way of direct attachment of microorganisms. Contributing modes of attachment included a mechanical locking of the calculus mass into splits along the dentinal tubules and into root planing irregularities. Author (TAB)

N66-35717# Argonne National Lab., Ill.
THE NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS OF VARIOUS ORDER
C. W. Gear Jan. 1966 40 p refs
(Contract W-31-109-ENG-38)
(ANL-7126) CFSTI: HC $2.00/MF $0.50

Modified multistep predictor-corrector methods are described for general initial-value problems and new methods are introduced. These new methods are of degree 2k for k-step methods and require only one function evaluation. Equivalence classes of methods are discussed, and it is argued that the Nordsieck formulation is the best for high-accuracy problems, and that for low-accuracy problems either the Nordsieck formulation or versions of the new methods should be used. The direct application of the methods to higher-order equations is analyzed, and some numerical evidence is given to suggest that this application leads to faster and more accurate methods than the usual method of integrating a system of first-order equations. Some preliminary tests on the integration of singular families are mentioned. Finally, existence and convergence proofs are presented. Author (NSA)

N66-35735*# Pittsburgh Univ., Pa. Space Research Coordination Center.
A CLASS OF RELATED SPACE-TIMES
A. H. Thompson 29 Oct. 1965 9 p refs Submitted for Publication
(Grant NsG-416)
(NASA-CR-68887; SRCC-17) CFSTI: HC $1.00/MF $0.50
CSCL 12A

Consideration is given to a previously derived solution of the vacuum field equations $R_{ab}=0$, for a space-time with metric tensor g_{ab} of the form $g_{ab}=\eta_{ab}+k_a k_b$. Here η_{ab} is the metric of Minkowski space in cartesian coordinates, but not necessarily rectangular; and k_a is a null vector field with $g^{ab}k_a k_b=0$. The contravariant components of the metric tensor take the simple form $g^{ab}=\eta^{ab}-k^a k^b$, where $k^a=g^{ab}k_b$; consequently k_a is also a null vector of the flat space-time. Generally, given an arbitrary space-time $\bar{V}_4$ with metric tensor $\bar{g}_{ab}$, and a null vector field k_a, then the tensor $g_{ab}=\bar{g}_{ab}+k_a k_b$ can be considered as the metric tensor of a related space-time V_4. In this note the relationship of V_4 to $\bar{V}_4$ is considered, and a generalization of the above result concerning the Petrov type of V_4 when $\bar{V}_4$ as a flat space-time is given. C.T.C.

N66-35770*# Denver Univ., Colo. Dept. of Chemical Engineering.
ERRORS INCURRED IN THE REDUCTION AND MATHEMATICAL MODELING OF PROCESS DYNAMIC DATA Final Report
R. Gailor Justice Jun. 1966 34 p refs
(Grant NsG-518)
(NASA-CR-77605; DRI-2333) CFSTI: HC $2.00/MF $0.50
CSCL 12A

The physical system analyzed was the dissipation of a tracer injection in a fluid flowing through a tube. The partial differential equation representing this system is the well known one-dimensional axial dispersion equation. The solutions of this equation in the time domain, the frequency domain and the Laplace domain are given. Thirty-three sets of experimental data with dynamic material balances varying from less than 1% to greater than 40% were analyzed. These data were correlated to the mathematical model in the three domains. It was found that no significant discrepancies existed between the parameters determined in the three domains. However, due to the behavior of the numerical Laplace

transform around zero and the author's inability to transform a consistent least squares argument into this domain, it was decided to eliminate this method of data reduction from further consideration. The Peclet number varied significantly between the normalized and unnormalized data when the material balance deviation was greater than 15%. Normalization had little effect on the effective residence time. Residual surfaces were steep for variations in the effective residence time, and were shallow and elongated for variations in the Peclet number. Author

N66-35779*# Consultants and Designers, Inc., Arlington, Va.
ON THE ACCUMULATION OF ERRORS AT NUMERICAL INTEGRATION IN SOME PROBLEMS OF CELESTIAL MECHANICS [O NAKOPLENII OSHIBOK PRI CHISLENNOM INTEGRIROVANII V NEKOTORYKH ZADACHAKH NEBESNOY MEKHANIKI]
A. S. Sochilina 25 Apr. 1966 14 p refs Transl. into ENGLISH from Byul. Inst. Teor. Astron. (USSR), v. 7, no. 4, 1959 p 281–286
(Contract NAS5-9299)
(NASA-CR-77703; ST-CM-10480) CFSTI: HC $1.00/MF $0.50 CSCL 03C

The results are expounded of the application of Myachin's estimates of errors in numerical integration of the equation of motion in the case of a problem of n bodies. Several numerical examples are given. Author

N66-35783*# Florida State Univ., Tallahassee. Dept. of Statistics.
A NEWTON-GRADIENT METHOD FOR NON-LINEAR PROBLEMS IN HILBERT SPACE Technical Report No. 7
Duane A. Meeter 24 Aug. 1966 16 p refs
(Grant NGR-10-004-029)
(NASA-CR-77682) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Reported is the development of a Newton-gradient method for extending Marquardt's algorithm for least squares estimation of nonlinear parameters to real Hilbert space. S.C.W.

N66-36078*# Maryland Univ., College Park. Computer Science Center.
MONOTONE ITERATIONS FOR NONLINEAR EQUATIONS WITH APPLICATION TO GAUSS-SEIDEL METHODS
James M. Ortega and Werner C. Rheinboldt Jul. 1966 44 p refs
(Grant NsG-398)
(NASA-CR-77762; TR-66-32) CFSTI: HC $2.00/MF $0.50 CSCL 12A

In this paper we study iterative processes of the form $y_{k+1}=y_k-B_kFy_k$ for approximating solutions of a system of nonlinear equations $Fy=0$. We obtain monotonic behavior of the iterates y_k in the sense of the natural partial ordering in real n-dimensional Euclidean space, if F statisfies a generalized convexity condition and the B_k are subinverses of $F'(y_k)$, i.e. $B_kF'(y_k)\leq I$, $F'(y_k)B_k\leq I$. We also study two-sided iterations as well as iterations defined by implicit processes such as the nonlinear Gauss–Seidel method. In addition, a class of iterative processes combining Newton's method with the Gauss–Seidel iteration is considered and an application is made to mildly nonlinear boundary-value problems. Author

N66-36114*# Lockheed Missiles and Space Co., Palo Alto, Calif.
STUDY OF PERTURBED PERIODIC SYSTEMS OF DIFFERENTIAL EQUATIONS—THE STROBOSCOPIC METHOD
C. M. Petty, W. E. Johnson, R. J. Dickson, A. Feinstein, and T. R. Jenkins Washington, NASA, Sep. 1966 58 p refs
(Contract NAS7-382)
(NASA-CR-583) CFSTI: HC $2.50/MF $0.75 CSCL 12A

Consideration is given to the class of differential equations of the form $u'=F(u, \epsilon, t)$ where u is an N-vector, ϵ a small parameter, and t the independent variable. The function $F(u, \epsilon, t)$ is assumed to be periodic in t of period $T>0$ for all u and ϵ, and the unperturbed equation $z'=F(z, 0, t)$ is assumed to have the property that all its solutions are periodic of period T. The principal problem is the determination of a stroboscopic differential equation of $u'=F(u, \epsilon, t)$ with the properties $\phi(y, \epsilon, 0)=y$ and $(y, \epsilon, t+T)=\phi(y, \epsilon, t)$, such that if $v(x, \epsilon, t)$ is a solution to an autonomous system of the form $v'=g(v, \epsilon)$ and $g(v, 0)=0$ then $u=\phi(v(x, \epsilon, t), \epsilon, t)$ is a solution to $u'=F(u, \epsilon, t)$. A formal computation is given of the stroboscopic differential equation and the transformation $\phi(y, \epsilon, t)$. Certain special systems are investigated for which exact convergence theorems are given for the stroboscopic representation of the solutions, and specific information regarding the form and qualitative behavior of the solution is included. The formal part of the general theory is developed, and a convergence theorem is stated and proved. C.T.C.

N66-36133*# National Aeronautics and Space Administration. Marshall Space Flight Center. Huntsville, Ala.
VARIATIONAL PROBLEMS AND THEIR SOLUTION BY THE ADJOINT METHOD
Roger R. Burrows 9 May 1966 69 p refs
(NASA-TM-X-53459) CFSTI: HC $3.00/MF $0.75 CSCL 12A

A variational problem typical of those encountered in flight mechanics is posed. The adjoint technique is then developed in a manner to indicate its application to general two-point boundary value problems. It is then specifically applied to the variational problem. Finally, the practicality of the adjoint method is illustrated by solving three typical problems of exo-atmospheric flight and one problem involving an ascent through the atmosphere to low earth orbit. Author

N66-36221# Wisconsin Univ., Madison. Dept. of Statistics.
ON STATISTICALLY INSPIRED CONDITIONS FOR THE GROUP STRUCTURE OF INVARIANT EXPERIMENTS
Mervyn Stone Apr. 1966 24 p refs
(Contract Nonr-1202)
(TR-67; AD-634769) CFSTI: HC $1.00/MF $0.50

The paper examines, within the context of group theory, the close links between the condition of Haar controllability (which ensures that the quasi posterior distributions for a group invariant experiment with respect to right Haar measure as quasi prior obey a natural requirement) and similar conditions imposed in the same context (to ensure decision theoretically desirable properties of invariant procedures) by Peisakoff, Kudo, Kiefer and Hunt, Stein and Lehmann. A counter conjecture is given and a direct proof of a counter example to the possible vacuity of these conditions is established. Partial insight into the above links is established by further linkage with wide sense Bayes procedures. Author (TAB)

N66-36262*# RAND Corp., Santa Monica, Calif.
A BAYESIAN APPROACH TO RELIABILITY ASSESSMENT
B. L. Fox Aug. 1966 27 p refs
(Contract NASr-21(11))
(NASA-CR-77910; RM-5084-NASA) CFSTI: HC $2.00/MF $0.50 CSCL 12B

Bayesian analysis was used to specify prior distribution parameters for the reliability of a unit that performs satisfactorily or not throughout an Apollo mission, and for the failure rate of a unit that fails according to exponential distribution. Prior distribution is based on analogous components and engineering estimates, and testing data are merged

with the prior distribution via Bayes rule to obtain the reliability assessment. Tables of the computed prior distribution parameters are appendixed. G.G.

N66-36323*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ESTIMATION IN THE NEGATIVE BINOMIAL DISTRIBUTION
A. Clifford Cohen, Jr. (Georgia Univ.) 21 Dec. 1965 38 p refs Research Done by Georgia Univ.
(Contract NAS8-11175)
(NASA-TM-X-53372) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Practical simplified procedures are developed in this paper for calculating estimates of parameters of the negative binomial distribution with probability function

$$f(x) = \frac{\Gamma(x+k)}{x!\,\Gamma(k)}\, p^k(1-p)^x;\ x = 0, 1, 2 \ldots$$

where $0 < p < 1$ and $k > 0$. Moment estimators, maximum likelihood estimators, and estimators based on moments and frequencies in selected classes are given both for the complete and for the truncated (with missing zero class) distribution. To facilitate calculation of the various estimators given, a table of the function $-p\ \ln p/(1-p)$ with entries to six decimals at intervals of 0.0001 for the argument p, is included. Illustrative examples are also included. Author

N66-36393# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ON THE METHOD OF NUMERICAL COMPUTATION OF DISPERSIVE NONLINEAR EQUATION
Akizi Outi and Nobuo Yajima Jun. 1966 15 p refs
(IPPJ-49) CFSTI: HC $1.00/MF $0.50

In order to examine the difference schemes to obtain numerical solutions of dispersive nonlinear equations a model equation is considered which is derived from the Schrödinger equation and is solvable exactly. By comparing the numerical solutions with the corresponding exact solutions it is found that Kruskal–Zabusky's scheme applied to the Kortweg–de Vries equation approximates well the exact solution. Author

N66-36409*# Innsbruck Univ. (Austria).
SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS BY MEANS OF LIE SERIES
Ferdinand Cap, D. Floriani, W. Groebner, A. Schett, and J. Weil Washington, NASA, Aug. 1966 134 p refs
(Grant NGR-52-046-001)
(NASA-CR-552) CFSTI: HC $3.00/MF $1.00 CSCL 12A

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3. THE SOLUTION OF THE GENERAL INHOMOGENEOUS LINEAR DIFFERENTIAL EQUATION OF SECOND ORDER A. Schett and J. Weil p 18–24 refs (See N66-36411 21-19)
4. SOLUTION OF THE EQUATIONS RESULTING FROM A SEPARATION OF THE HELMHOLTZ EQUATIONS IN SPECIAL COORDINATE SYSTEMS A. Schet and J. Weil p 25–56 refs (See N66-36412 21-19)
5. APPLICATIONS IN PHYSICS A. Schett and J. Weil p 57–62 refs (See N66-36413 21-23)
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N66-36410*# Innsbruck Univ.(Austria).
THE SOLUTION OF THE GENERAL HOMOGENEOUS LINEAR DIFFERENTIAL EQUATION OF SECOND ORDER
A. Schett, J. Weil, and W. Groebner *In its* Soln. of Ordinary Differential Equations by Means of Lie Ser. Aug. 1966 p 5–17 refs (See N66-36409 21-19) CFSTI: HC $3.00/MF $1.00

Two methods using Lie series for the solution of the equation are presented: recurrence formulas and iteration. Using recurrence formulas, the equation is treated:

$$Z''(t) - f_1(t)Z'(t) - f_2(t)Z(t) = 0$$

This equation represents the most general type of the equations resulting from a separation of the Helmholtz equation. Two alternative representations of the solution are described, one of them still containing the D-operators and the other one split up into trigonometric functions and remaining terms for which recurrence formulas could be derived. In the iterative method of solution, the Lie operator D is split with the intention of putting most of the operator into the main part of the solution and to keep a part of the operator for the formation of the remaining terms. E.A.O.

N66-36411*# Innsbruck Univ. (Austria).
THE SOLUTION OF THE GENERAL INHOMOGENEOUS LINEAR DIFFERENTIAL EQUATION OF SECOND ORDER
A. Schett and J. Weill *In its* Soln. of Ordinary Differential Equations by Means of Lie Ser. Aug. 1966 p 18–24 refs (See N66-36409 21-19) CFSTI: HC $3.00/MF $1.00

Using Lie series, an iterative method and a method of recurrence formulas are described for the solution of the $Y''(t) - f_1(t)Y'(t) - f_2(t)Y(t) = f_3(t)$ equation. In the iterative method, the D-operator is split into D_1 and D_2, where D_1 will produce the main part and D_2 the correction terms. A perturbation integral obtained in the derivation of the solution can be evaluated by an iteration method. A solution obtained by the use of recurrence formulas is presented. It is stated that no way of estimating the error made by breaking off the computation seems to exist for the recurrence formulas. E.A.O.

N66-36412*# Innsbruck Univ. (Austria).
SOLUTION OF THE EQUATIONS RESULTING FROM A SEPARATION OF THE HELMHOLTZ EQUATIONS IN SPECIAL COORDINATE SYSTEMS
A. Schett and J. Weil *In its* Soln. of Ordinary Differential Equations by Means of Lie Ser. Aug. 1966 p 25–56 refs (See N66-36409 21-19) CFSTI: HC $3.00/MF $1.00

Application of Lie series to various specific cases of the differential equations is considered. The most general type of the equation is written:

$$Z''(t) - f_1(t)Z'(t) - f_2(t)Z(t) = 0.$$

The Helmholtz equation is separated in 11 coordinate systems, including rectangular, circular-cylinder, elliptic-cylinder, parabolic-cylinder, spherical, prolate-spheroidal, oblate spherical, parabolic, conical, ellipsoidal, and paraboloid coordinates. Ten types of the general equation are derived. Since the Lie solution is only valid for regular functions, consideration is limited to regular domains. The individual

types of equations are subsumed under generalized types, and under each type the special cases in which it appears are mentioned. E.A.O.

N66-36414*# Innsbruck Univ. (Austria).
REPRESENTATION AND COMPUTATION OF MATHIEU FUNCTIONS BY MEANS OF LIE SERIES
Ferdinand Cap and D. Floriani *In its* Soln. of Ordinary Differential Equations by Means of Lie Ser. Aug. 1966 p 63-107 refs (See N66-36409 21-19) CFSTI: HC $3.00/MF $1.00

The general equation $v''(u) - h(u) \cdot v(u) = g(u)$ is solved using the Lie operator, preliminary to the treatment of Mathieu's equation. The ordinary form of the equation $y''(x) = (2q \cdot \cos 2x - \lambda) \cdot y(x)$ and the modified form $Y''(x) = (\lambda - 2q \cdot Ch2x) \cdot Y(x)$ are both solved. Mathieu functions of nonintegral and integral orders are then treated. Descriptions and flow diagrams are given for several computer programs which included computation of the Mathieu functions by means of Lie series and the calculation of the eigenvalue of the Mathieu differential equation. It is stated that certain difficulties attend the exact calculation of the Mathieu functions and the use of Lie series, but the use of the Lie series does yield satisfactory results. E.A.O.

N66-36415*# Innsbruck Univ. (Austria).
THE NUMBERICAL CALCULATION OF WEBER PARABOLIC CYLINDER FUNCTIONS
A. Schett and J. Weil *In its* Soln. of Ordinary Differential Equations by Means of Lie Ser. Aug. 1966 p 109-122 refs (See N66-36409 21-19) CFSTI: HC $3.00/MF $1.00

From a separation of a Helmholtz equation in parabolic-cylinder coordinates, three equations were obtained, the first two of which were solved by Weber parabolic-cylinder functions. A short review is presented of all three formulas representing the solution of the general homogeneous linear differential equation based on Lie series formalism. Mathematical tables are included giving various values of Lie series results and results from paraboloid coordinates. L.E.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-35470# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
MESOMETEOROLOGICAL STUDIES Final Report, 11 Feb. 1965-31 Jan. 1966
Rodger A. Brown Bedford, Mass., AFCRL, Apr. 1966 115 p refs
(Contract AF 19(628)-4807; Grants Cwb-WBG-41; Cwb-WBG-70)
(AFCRL-66-338; AD-634305) CFSTI: HC $4.00/MF $0.75

CONTENTS:

1. ON THE DETERMINATION OF EXCHANGE COEFFICIENTS: PART II: ROTATING AND NONROTATING CONVECTIVE CURRENTS R. A. Brown 30 p refs (See N66-35471 21-20)
2. ON THE "THUNDERSTORM—HIGH CONTROVERSY" R. A. Brown 26 p refs (See N66-35472 21-20)
3. SATELLITE AND MESOMETEOROLOGY RESEARCH PROJECT: THREE-DIMENSIONAL GROWTH CHARACTERISTICS OF AN OROGRAPHIC THUNDERSTORM SYSTEM R. A. Brown 45 p refs (See N66-35473 21-20)

N66-35471# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
ON THE DETERMINATION OF EXCHANGE COEFFICIENTS: PART II: ROTATING AND NONROTATING CONVECTIVE CURRENTS
Rodger A. Brown *In its* Mesometeorological Studies Apr. 1966 30 p refs (See N66-35470 21-20) CFSTI: HC $4.00/MF $0.75

A set of equations is proposed for computing eddy viscosity and diffusion coefficients within rotating and nonrotating convective currents. The equations are especially well suited for numerical simulations because the only parameters upon which they depend are the three components of wind velocity. Since the equations are based more on intuition than physical arguments, they are evaluated for simplified models in an attempt to show that they have an implicit physical basis. The physical validity of the equations becomes most obvious when the computed values are compared with those for an actual cumulonimbus and for noncloud data. One outcome of this study is the revision of a universal relation originally proposed whereby the exchange coefficient for various scales of atmospheric motion can be determined from a characteristic length, which is a measure of the degree of turbulence. Author

N66-35472# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
ON THE "THUNDERSTORM—HIGH CONTROVERSY"
Rodger A. Brown *In its* Mesometeorological Studies Apr. 1966 26 p refs (See N66-35470 21-20) CFSTI: HC $4.00/MF $0.75

The "Thunderstorm—High Controversy" came about when attempts were made to explain, from dynamical considerations (i.e., vertically accelerating and decelerating air), the high pressure in the pressure nose which forms beneath thunderstorms. Some meteorologists attributed the pressure rise to upward accelerating air, but others concluded that such accelerations should produce a pressure dip. Authors, who refer to the papers involved, mistakenly assume that precipitation downdrafts were being considered as the cause of the rise, as is now accepted. Therefore the purpose of this paper is twofold: first, to investigate the assumptions made in the papers and point out implicit and explicit errors; and, second, to explain pressure changes beneath an idealized developing thunderstorm in terms of the integrated influences of hydrostatic and hydrodynamic pressure within and beneath the cloud. Author

N66-35473# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
SATELLITE AND MESOMETEOROLOGY RESEARCH PROJECT: THREE-DIMENSIONAL GROWTH CHARACTERISTICS OF AN OROGRAPHIC THUNDERSTORM SYSTEM
Rodger A. Brown May 1966 *In its* Mesometeorological Studies Apr. 1966 45 p refs (See N66-35470 21-20) CFSTI: HC $4.00/MF $0.75
(SMRP-RP-61)

A thunderstorm, which developed over the San Francisco Peaks near Flagstaff, Arizona on 1 August 1961, is studied with the use of surface stereo-pair and aerial photographs. The photographs are used to investigate both the vertical growth rate of the tops of numerous cloud elements and the rate of increase of mass within the entire cloud system. Photographic evidence of the unique cloud feature which signifies the transition from a cumulus congestus into a cumulonimbus is presented. Analyses of surface data from the mesometeorological network aroung the peaks reveal that the precipitation area remained near the leeward slopes as the mountain-anchored cloud mass extended to the north. Based on this and previous studies, the energy available for the growth of

cumuli and cumulonimbi are determined; values of the order of 10^{22} ergs for cumulonimbi agree with values obtained by Braham (1952), who used an entirely different approach. The Appendix contains a detailed description of the photogrammetric techniques used to obtain measurements from the clouds seen in the aerial photographs. Author

N66-35637# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

OBSERVED DIURNAL OSCILLATIONS OF PRESSURE AND DENSITY IN THE UPPER STRATOSPHERE AND LOWER MESOSPHERE

Otto W. Thiele Ft. Monmouth, N. J., Army Electron. Command, Apr. 1966 28 p refs

(ECOM-5047; AD-634884) CFSTI: HC $2.00/MF $0.50

Two recent series of meteorological rocket measurements in the upper stratosphere and lower mesosphere conducted in the summer and fall of 1965 at White Sands Missile Range, New Mexico, indicate a significant diurnal oscillation of pressure and density in this region. The amplitude of observed pressure oscillations over an averaged layer from 52 to 58 km varied from 4 to 7 percent with a mean value of 5 percent while the amplitude of density averaged through the same layer varied from 3 to 5 percent with a mean of 3.5 percent. Harmonic analyses of the heights of the 1.0, 1.6 and 1.4 mb surfaces indicate maxima at approximately 1400 and 1200 hours (local time) for the summer and fall series, respectively. In the vicinity of 55 km the total range of the diurnal oscillations of pressure and density as evidenced by these data was found to be almost as large as the seasonal variability. Author (TAB)

N66-35676# National Engineering Science Co., Houston, Tex.

STATISTICAL PROPERTIES OF RADAR ECHO PATTERNS AND THE RADAR ECHO PROCESS. THE ROLE OF THE KUTTA-JOUKOWSKI FORCE IN CLOUD SYSTEMS WITH CIRCULATION

Larry Armijo and Joseph L. Goldman Washington, Natl. Severe Storms Lab., Jun. 1966 41 p refs

(Contract Cwb-11127)

(TN-48-NSSL-27)

CONTENTS:

1. STATISTICAL PROPERTIES OF RADAR ECHO PATTERNS AND THE RADAR ECHO PROCESS L. Armijo p 1-19 refs (See N66-35577 21-07)

2. THE ROLE OF THE KUTTA-JOUKOWSKI FORCE IN CLOUD SYSTEMS WITH CIRCULATION J. L. Goldman (Natl. Eng. Sci. Co.) p 21-34 refs (See N66-35578 21-20)

N66-35678# National Engineering Science Co., Houston, Tex.

THE ROLE OF THE KUTTA-JOUKOWSKI FORCE IN CLOUD SYSTEMS WITH CIRCULATION

Joseph L. Goldman *In its* Statist. Properties of Radar Echo Patterns and the Radar Echo Process. The Role of the Kutta-Joukowski Force in Cloud Systems with Circulation Jun. 1966 p 21-34 refs (See N66-35576 21-30)

The classical Kutta-Joukowski Force produces acceleration of a translating cylinder immersed in fluid with circulation, in a direction normal to the cylinder motion. The motion of large thunderstorms has been observed to deviate systematically from environmental winds and the possible association of the K-J Force with storm motions is discussed. Author

N66-35674# Institut Royal Meteorologique de Belgique, Brussels.

CLIMATOLOGIC OUTLINE OF THE KING BADOUIN BASE IN ANTARCTICA [ESQUISSE CLIMATOLOGIQUE DE LA BASE ROI BAUDOUIN EN ANTARCTIQUE]

Francois E. Bastin 1966 116 p refs In FRENCH */in* Publ. Ser. A, No. 56

CFSTI: HC $4.00/MF $1.00

To aid in the study of weather conditions, a statistical analysis is presented on climatological observations in polar regions. Data are reported for daily, five-day, monthly, and yearly averages; and, frequencies and extremes for the principal climatological elements, including: atmospheric pressure, surface conditions, winds with their absolute frequencies of velocity in all directions, visibility, daily insolation in hours and tenths of hours, fog, snow, visible sky, absolute minimum and maximum temperatures, cloud classification, and number of days of precipitation. It is noted that comparisons with the previous year show significant differences. It is felt that while the period of observation is too short to draw conclusions on climate, the observations are important because they give climatological data on a hitherto slightly explored region. Transl. by R.Ll.

N66-35752# Joint Publications Research Service, Washington, D. C.

PREPARATION OF RESULTS OF HYDROMETEOROLOGICAL OBSERVATIONS FOR PROCESSING ON ELECTRONIC COMPUTERS

N. K. Klyukin 29 Aug. 1966 13 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 8, 1966 p 53-58 (JPRS-37275; TT-66-33704) CFSTI: $1.00

Means of preparing information for automated processing are discussed, with details given on the use of a blank document and its microfilm. The left side is used for recording data; the right side is reserved for coding the information. The filled blanks are microfilmed on 35 mm film, which is used for input of the information into an electronic computer, and for information storage. Also proposed are blank forms with a normalized manuscript text (figures), and a device for automatic counting of the text from these blanks; and a mechanical device with a coding instrument for copying information onto a five-channel telegraphic punch tape. Procedures for transmitting routine information from an incompletely automated station are listed for the station, and for a first order territorial center. M.G.J.

N66-35753# Joint Publications Research Service, Washington, D. C.

PRESENT STATUS OF NUMERICAL WEATHER FORECASTING METHODS

G. I. Marchuk 29 Aug. 1966 19 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 8, 1966 p 12-20 Presented at the Session of the Sci. and Tech. Council of the Main Admin. of the Hydro-Meteorol. Serv., 11 Feb. 1966 (JPRS-37280; TT-66-33709) CFSTI: $1.00

The theory of hydrodynamic description of meteorological elements, and numerical methods of weather forecasting are considered in relation to the problems involved. Short range weather forecasting models are evaluated, with barotropic models, baroclinic forecasting models in a quasigeostrophic approximation, and nongeostrophic models of a baroclinic atmosphere considered. The need for improved approximation based on geometrical variables is pointed out. Various approaches taken in developing models for 3 to 5 day, and long-range weather forecasts are also assessed, along with theoretical models of general atmospheric circulation. The status of computer mathematics and computer apparatus is reviewed, and the development of algorithms for numerical solution of meteorological problems is discussed. Methods of objective analysis of meteorological fields are summarized, and studies on the relationship of atmospheric physics to weather forecasting are surveyed. M.G.J.

N66-35765# Joint Publications Research Service, Washington, D. C.

IS IT POSSIBLE TO INFLUENCE THE CLIMATE AND THE WEATHER?

A. M. Gusev 16 Aug. 1966 67 p Transl. into ENGLISH from the book "Klimat i Pogoda" Moscow, "Nauka" Publishing House, 1966 p 73–122

(JPR-37032; TT-66-33462) CFSTI: $3.00

The economic impact which would result from climate and weather control is discussed, and the international aspects of such a program are stressed. Several methods of modifying meteorological processes are examined, and the energy of different meteorological processes is considered. Experiments in controlling the weather are reviewed, with particular attention given to cloud modification, such as seeding; fog scattering; hail dissipation; heating of the surface layer of air; and heat exchange between the surface of the soil and the thin air layer directly adjacent to this surface. Ways of transforming the earth's climate are also assessed, and the need for safeguarding the most optimal climate of the planet from its natural changes emphasized. It is pointed out that all projects for transforming climate should be checked out on the basis of conclusions drawn from theory, and with the assistance of both laboratory and natural models of climate phenomena. M.G.J.

N66-35942*# National Aeronautics and Space Administration, Washington, D. C.

THIRD ESSA SATELLITE LAUNCH SCHEDULED FOR SEPTEMBER 21

19 Sep. 1966 19 p Prepared in cooperation with ESSA (NASA-ESSA Release-ES-66-54) Available from the Scientific and Technical Information Division CSCL 22B

The launching of the third Environmental Science Services Administration (ESSA) weather satellite, which will provide global weather pictures for central processing and analysis, is described. As the third environmental survey satellite in the TIROS operational satellite system, ESSA will carry two advanced vidicon camera systems—each capable of complete daily picture coverage of the earth's weather—and an array of atmospheric radiation sensors. Photographs are used to produce cloud maps that pinpoint existing weather systems around the world and to aid in preparing global weather analysis and forecasts. Background information on television cameras, picture acquisition and analyses, radiation sensors, and flight plan accompany the discussion. S.P.

N66-35944*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SYNCHRONOUS OPERATIONAL METEOROLOGICAL SATELLITE FEASIBILITY STUDY

Jun. 1966 118 p refs

(NASA-TM-X-55555; X-731-66-271) CFSTI: HC $3.00/MF $1.00 CSCL 22B

A spin scan camera for daytime observation of cloud cover to be flown and the first launch of the Applications Technology Satellite is described. Means of exploiting this new technique on a quick reaction basis by use of existing synchronous satellite technology are suggested. The method chosen leans heavily on the use of HS-303A (Intelstat II) with redundant spin scan cameras added. Objectives of the synchronous operational meteorological feasibility study are related; and constraints in planning the systems, cost, and schedule are briefly discussed. Various tradeoffs are mentioned and evaluated and a feasible system definition is reached. Subsystems such as the meteorological equipment, transponder, telemetry, and power supply are mentioned. Ground stations for servicing the spacecraft and relaying data and/or obtaining data are discussed. The thrust augmented improved Delta vehicle and the apogee motor used in the overall vehicle are examined. S.P.

N66-35986# Joint Publications Research Service, Washington, D. C.

EXPERIENCE IN DEVELOPING A SYNOPTIC-STATISTICAL METHOD FOR FORECASTING ANOMALIES OF SEASONAL PRECIPITATION

N. A. Aniskina and I. B. Lyapunova 29 Aug. 1966 16 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 6, 1966 p 31–35 refs

(JPRS-37282; TT-66-33711) CFSTI: $1.00

The quantitative synchronous relationships of precipitation with the mean monthly air pressure in the northwestern part of the U.S.S.R. was evaluated statistically and used to predict seasonal forecasting anomalies. Integral curves of the yearly pressure anomalies were compared to the curves of the annual precipitations anomalies; cyclic fluctuations in the shapes of the integral curves reflected cyclo- and anticyclonic atmospheric circulation activities. This dependence of pressure anomalies and precipitation fluctuations led to a 63% accurate prediction of precipitation anomalies with an admissable error of $\pm 0.674\sigma$. G.G.

N66-35987# Joint Publications Research Service, Washington, D. C.

NUMERICAL MODEL FOR SHORT-RANGE FORECASTING OF STRATIFORM CLOUD COVER

Yu. G. Lushev et al 16 Aug. 1966 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz. Mat. (Moscow), v. 167, no. 4–6, 1966 p 1042–1045 refs

(JPRS-37030; TT-66-33460) CFSTI: $1.00

A cloud cover model was formulated by determining the dew point spread for corresponding isobaric surfaces from points of intersections taking into account the spread of air temperature and cloud cover data from surface weather charts. A total of 1,540 points were analyzed and successful forecasts for cloudy and clear weather were obtained with an accuracy of about 79%. G.G.

N66-35998# Weather Bureau, Washington, D. C.

AN EXPERIMENT IN PROBABILITY PRECIPITATION FORECASTING

Glenn Stallard Oct. 1965 17 p refs

(TN-19-ER-1; PB-169809)

During the period from Feb. 1, 1963, through Jan. 31, 1965, an experiment in subjective probability precipitation forecasting was conducted. Probabilities were assigned four times daily by the duty forecaster for each 12-hr. interval of the valid forecast periods. An exception was at 1600 GMT (1100 EST) when "THIS AFTERNOON" (1300–1900 EST) constituted the first forecast interval, and a probability forecast was not made for "TOMORROW NIGHT". Generally categories were listed at 10 percent intervals, but smaller intervals were frequenctly used for very low probabilities and occasionally 95 percent or 98 percent were used for very high probabilities. Zero and 100 percent were discouraged for all forecast intervals except the first. The forecasts were made for Philadelphia with a measurable amount of precipitation at International Airport required for verification. For comparison climatological probabilities were computed, based upon the most recent 20 yr. of record. 22.5 percent was found to be the average climatological probability for the day–night intervals, 18 percent for the afternoon, and 21 percent for daytime probability. Author

N66-36044# Defence Research Board, Ottawa (Ontario).
SECULAR FLUCTUATIONS OF THE CONTINENTALITY OF THE CLIMATE AT MOSCOW
L. V. Klimenko Oct. 1963 3 p Transl. into ENGLISH from Izv. Vsesoyuznogo Geograficheskogo Obshchestva (USSR), v. 95, no. 4, 1963 p 367–368
(T-395-R; AD-610941) CFSTI: HC $1.00/MF $0.50

The yearly amplitude of the temperature at Moscow (July to January) was calculated for 140 years, starting from 1821, since from that year on there have been no gaps in the published data for the mean monthly temperature at Moscow. The integral curve of yearly amplitudes constructed from these data (by summing the departures from the long-term means) shows that the variations of continentality fall into four well-expressed periods, mainly reflecting fluctuations in the January temperature: (1) From the end of the 1820's to the beginning of the 1860's, a period when there prevailed stable high indices of continentality, due to a low January temperatures; (2) from the beginning of the 1860's to the end of the 1890's the continentality was subject to brief fluctuations in either direction, with a slight falling trend; (3) from the end of the 1890's to the middle of the 1920's there was observed a period of markedly declining continentality, due to just as marked a rise of the January temperature, and also a quite considerable fall of July temperature; and (4) from the middle of the 1920's until 1960 the continentality underwent fluctuations in either direction, with a slight rising trend. TAB

N66-36167# Institut Royal Meteorologique de Belgique, Brussels.
THE 1959 BELGIAN ANTARCTIC EXPEDITION: METEOROLOGICAL SURFACE OBSERVATIONS [EXPEDITION ANTARCTIQUE BELGE 1959. OBSERVATIONS METEOROLOGIQUES EN SURFACE]
Frank E. Bastin 1966 111 p In FRENCH *Its* Publ. Ser. A, No. 57
CFSTI: HC $4.00/MF $0.75

Tabular data cover surface meteorological observations made from Capetown, onboard ship, and at the Antarctic base. Daily, three-hour observations are recorded for the year, Greenwich time. Also included are data on wind velocity and direction, cloud classification and height, horizon visibility, atmospheric pressure, air temperature, barometric tendency, extremes of temperature, insolation, latitude, and longitude. Transl. by R. Ll.

N66-36213# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
LITTLE JOHN MISSILE NO. 2129, ROUND NO. 645 RM (25 APRIL 1966) Meteorological Data Report
Jun. 1966 20 p
(DR-26; AD-634695) CFSTI: HC $1.00/MF $0.50

Meteorological data gathered for the launching of Little John, missile number 2129, round number 645 RM, appear in tabular form. Author (TAB)

N66-36215# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
LITTLE JOHN MISSILE NO. 2126, ROUND NO. 643 RM (14 APRIL 1966) Meteorological Data Report
Jun. 1966 31 p
(DR-24; AD-634760) CFSTI: HC $2.00/MF $0.50

Meteorological Data gathered for the launching of Little John, missile number 2126, round number 643 RM, are presented in tabular form. Author (TAB)

N66-36367*# Ludwig-Maximilians-Universitat, Munich (West Germany).
TROPOSPHERIC WATER VAPOR CONTENT AND SURFACE TEMPERATURES FROM TIROS IV RADIATION DATA
Ehrhard Raschke Washington, NASA, Sep. 1966 114 p refs (Grant NsG-305)
(NASA-CR-595) CFSTI: HC $3.00/MF $0.75 CSCL 04B

Radiometric measurements within the 6.3 micron band of water vapor and the 8–12 micron atmospheric window were made over a five month period from February to June 1962 from the TIROS IV meteorological satellite. Simultaneous measurements in these two spectral intervals have been analyzed to infer the spatial and temporal variations on a quasi-global scale of the following three quantities: (1) the mean temperature of the cloud top, land, or ocean surfaces, (2) the mean relative humidity of the upper troposphere, and (3) in conjunction with radiosonde temperature data, the water vapor mass above the 500 mb level. The results show three major regions of high moisture content over South America, Africa, and the Western Equatorial Pacific with several other lesser regions near the Intertropical Convergence Zone. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-36118*# Environmental Science Services Administration, Washington, D. C.
NAVY SATELLITE NAVIGATION SYSTEM
Frederick G. Paulsen Washington, NASA, Sep. 1966 85 p Sponsored by NASA and Dept. of Defense
(NASA-CR-612) CFSTI: HC $2.50/MF $0.75 CSCL 17G

Nonmilitary applications of Transit (presently called the Navy Satellite Navigation System) for deep-sea trackline survey work are evaluated for the purpose of obtaining a navigation position fix for a ship by data received from a satellite in orbit. The underway accuracy of the system as established by the best types of comparison control aboard the Navy ship, sextant angles, visual bearings, and shoran is approximately 0.17 miles average error. Dockside accuracy is of the same order, with an average error of approximately 0.16 miles. System reliability is established by the fact that for underway attempts at ship positioning, while eliminating low pass angles, the overall success percentage for in-port fixes was 94%. For underway positioning fix attempts, again eliminating low pass angles, the system was successful only 84% of the time. It is considered that the system is very favorable for use in controlling deep-sea survey work. R.Ll.

N66-36173# Communication Systems, Inc., Paramus, N. J.
FUTURE AIR-GROUND-AIR COMMUNICATION SUBSYSTEM INVESTIGATION. PARTS C,D,E,G,H, VOLUME IV Final Report
Jul. 1966 340 p refs
(Contract FA-WA-4645)
(RD-66-16, Vol. IV; CSI-66-TR-2147)

The projected requirements for the 1970–75 air-ground-air (A/G/A) communications subsystem, the design synthesis, and the simulation of the subsystems are discussed. The post 1970 air traffic control system and its environment is described, and the A/G/A communication traffic loading predictions and the required characteristics of the subsystem are developed. Details are presented on the system synthesis, the

modernization of the existing subsystems, the support program, and the planning aspects of the overall communication program. The analysis and model are described and provide the basis for development of a computer simulation queueing model. N.E.N.

N66-36174# Communication Systems, Inc., Paramus, N. J.
FUTURE AIR-GROUND-AIR COMMUNICATION SUBSYSTEM INVESTIGATION. PART A: INTRODUCTION, PART F: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS, VOLUME I Final Report
Jul. 1966 116 p refs
(Contract FA-WA-4645)
(RD-66-16, Vol. I; CSI-66-TR-2144)

The present air-ground-air communications system and the problems arising from the sustained rapid growth and technological progress are outlined. The principle results are discussed, and tables and graphs are included. Among the primary advantages of the proposed system are: (1) a segregation of aircraft-control from non-aircraft-control messages, (2) a compression of the controller's workload by use of more expeditious communication techniques, (3) operational implementation by 1970 of design changes, (4) a continuing evaluation of requirements and techniques for further modernization, and (5) close coordination of system upgrading plans with all affected parties, at national and international level. N.E.N.

N66-36175# Communication Systems, Inc., Paramus, N. J.
FUTURE AIR-GROUND-AIR COMMUNICATION SUBSYSTEM INVESTIGATION. PART J: APPENDICES 1 THRU IV, VOLUME V Final Report
Jul. 1966 274 p refs
(Contract FA-WA-4645)
(RD-66-16, Vol. V; CSI-66-TR-2148)

Appendices are presented in support of the study on post 1972 air-ground-air (A/G/A) communication subsystem. Parameters which may be used to characterize the present A/G/A communication subsystem and the air traffic environment are listed. The experiment design developed as part of the data collection plan is described, including the em-experiments on channal loading and communication traffic characteristics evaluation. The computer program for the data reduction and for the analysis of voice communication data and companion air traffic activity details is given. N.E.N.

N66-36181# Communication Systems, Inc., Paramus, N. J.
FUTURE AIR-GROUND-AIR COMMUNICATION SUBSYSTEM INVESTIGATION. PART B: CHARACTERIZATION OF THE PRESENT ATC A/G/A COMMUNICATION SUBSYSTEM AND ITS ENVIRONMENT, VOLUME III Final Report
Jul. 1966 358 p refs
(Contract FA-WA-4645)
(CSI-66-TR-2146; CSCI-66-TR-2146)

The message characteristics of the present center air-ground-air (A/G/A) communications subsystem are discussed, concluding the study on the present center subsystem. The quantitative characterization of present terminal area A/G/A subsystem is also discussed. Details are presented on: (1) communication loading in terms of an individual aircraft and in terms of an overall A/G/A channel, (2) analysis of communication traffic in terms of message types, and (3) development of the models relating air and communication traffic. An account of traffic flow in the A/G/A communication subsystem and evaluation of the performance of the subsystem is given. Deficiencies and disadvantages are identified, and distributions for key air traffic and communication flow parameters are included. N.E.N.

N66-36182# Communication Systems, Inc., Paramus, N. J.
FUTURE AIR-GROUND-AIR COMMUNICATION SUBSYSTEM INVESTIGATION. PART B: CHARACTERIZATION OF THE PRESENT ATC A/G/A COMMUNICATION SUBSYSTEM AND ITS ENVIRONMENT, VOLUME II Final Report
Jul. 1966 390 p refs
(Contract FA-WA-4645)
(RD-66-16; Vol. II; CSI-66-TR-2145)

The statistical data gathering procedures, and the qualitative and quantitative characterization of the present air-ground-air (A/G/A) communication subsystem and its environment are presented. The parameters describing the dense traffic conditions, and the communications with air traffic control are discussed. The acquisition of a suitable sample of field data for analysis is covered, including the computation of the required amounts and types of data, and the development of suitable computer programs for processing. The regulatory constraints on the communication subsystem are considered. A qualitative account of the A/G/A communications is presented. The communication traffic varying parameters of the A/G/A ARTC Center communication subsystem as a function of the air traffic parameters are described quantitatively. The channel loading parameters and the traffic characteristics are discussed. N.E.N.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-35465# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
Sn TRANSPORT CALCULATIONS FOR A GASEOUS CORE REACTOR
Carl F. Bloemker (M.S. Thesis) Mar. 1966 104 p refs
(GSP/PH/66-1; AD-635232) CFSTI: HC $8.00/MF $0.75

A nuclear analysis was performed on a gaseous core cavity reactor suitable for space propulsion. The reactor analyzed consisted of a spherical gaseous core reactor surrounded by a carbon beryllium reflector. To carry out this analysis, the angular segmentation (Sn) method was applied to the conservative form of the Boltzmann equation to obtain a set of finite difference equations. The finite difference equations were then incorporated into a computer code written by the author. The computer code was programed for the IBM 7094 coupled system using Fortran IV. The code was first applied to an idealized gas core reactor which was previously analyzed by T. F. Plunckett using sixteen group diffusion theory. The difference in critical mass was 8%. After this check on the reliability of the author's code, a parametric study on the gaseous core reactor was performed. The results of this study, which determined the critical mass as a function of core radii and design thrust, are presented. Author (TAB)

N66-35489# Reynolds Electrical and Engineering Co., Inc., Mercury, Nev. Radiological Sciences Dept.
PROJECT DRIBBLE—SALMON EVENT ON-SITE HEALTH AND SAFETY REPORT Final Report
J. Tell Tappan and William E. Moore, comp. Nov. 1965 54 p
(Contract AT(29-2)-162)
(VUF-1025; AD-635037) CFSTI: HC $2.00/MF $0.50

Radiation measurements were recorded during and after the detonation by a remote area monitoring system. After the

detonation, radiation monitors equipped with portable radiation detection instruments surveyed the route into surface ground zero before other planned reentries were made. Continuous surveillance was provided while personnel were in the area. Radiological sciences requirements included the following: (1) recording measurements of gamma dose rates; (2) measurements of radionuclide concentrations in air; (3) measurements of radionuclide concentrations in water; (4) toxic gas and explosive mixture measurements; (5) portable instrument measurements of gamma dose rates; and (6) portable instrument measurements of alpha radiation. Only background radiation measurements were observed from zero time until communication with the cavity was established during postshot drilling operations at a depth greater that 2600 feet. Fifty-two individuals received radiation doses in excess of 100 mrem during the Salmon Event program. The maximum accumulated individual dose was 1065 mrem (well below the dosage limits listed in the AEC manual, chapter 0524, of 3 rem per quarter and 5 rem per year). Author (TAB)

N66-35611# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
THERMAL NEUTRON MEASUREMENTS
W. M. Quam *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 39–71 refs (See N66-28715 16-04) CFSTI: HC $6.00/MF $1.25

Thermal neutron flux density is measured using gold foil activation techniques. The cadmium ratio is determined, and flux perturbation effects of gold foil are evaluated. Procedures for calibration and standardizations of the foil counting equipment are presented. Typical graphs are included. For general information, see N66-35608. N.E.N.

N66-35612# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
THRESHOLD FOILS FOR NEUTRON DETECTION
Kent C. Humpherys *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 72–96 refs (See N66-28715 16-04) CFSTI: HC $6.00/MF $1.25

A fission foil calibration factor is obtained using a known thermal neutron flux exposure of a bare Pu^{239} foil. This factor and decay curve are used with three fission foil materials for measurement of fast neutron flux densities. The foils are then used for a fast neutron integrated flux measurement, and the corresponding neutron kerma in the tissue is calculated. For general ninformation, see N66-35608. N.E.N.

N66-35614# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
A SCINTILLATION DOSIMETER
T. S. Dahlstrom *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 117–131 refs (See N66-28715 16-04) CFSTI: HC $6.00/MF $1.25

An air equivalent, plastic scintillator is coupled to a photomultiplier tube as a sensitive gamma dose rate meter. The exposure rate is determined directly, and the time-integrated current is the measure of the exposure. The theoretical-empirical determination of the dose–response proportionality constant is reviewed. For general information, see N66-35608. N.E.N.

N66-35615# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
SILVER-ACTIVATED PHOSPHATE GLASS MICRODOSIMETERS FOR GAMMA RAY DOSE MEASUREMENT
R. K. Durkee *In its* Manual of Radiation Dosimetry Expt. Nov. 1965 p 132–143 refs (See N66-28715 16-04) CFSTI: HC $6.00/MF $1.25

The glass dosimeter response to cobalt-60 radiation exposure is calibrated, and a simultaneous exposure of four dosimeter units is made in the fast neutron exposure room. These exposures utilize the energy discriminatory and thermal attenuation shields. A supplementary experiment is described to show the necessity of energy discriminatory shields using the 250 kvp X-ray machine. For general information, see N66-35608. N.E.N.

N66-35677# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
ESSOR FUEL ELEMENTS Final Report, 20 Jan.–20 Nov. 1962 [ELEMENTS COMBUSTIBLES ESSOR Rapport Final, 20 Jan.–20 Nov. 1962]
J. Depoitier, W. Timmermans, N. Huberlant, F. Mathieu, F. Marchal et al Brussels, EURATOM, Jun. 1966 104 p refs In FRENCH; ENGLISH summary
(Contract EUR-055-62-1 ORGS)
(EUR-2522.f) CFSTI: HC $4.00/MF $0.75

The ESSOR fuel element with a base of 20% U–Al may be compared to the BR2 element, several fabrication parameters of which have already been determined. Fabrication of a composite fuel plate for the ESSOR reactor has therefore been carried out by extrapolating these parameters. It has, however, been necessary, in order to limit the intermetallic compounds, to add to the fuel alloy an element stabilizing the UAl_3 phase, as a result of which the fuel alloy is still able to be laminated. Unfortunately this element hampers chemical analysis; however, promising results have been obtained by substituting gamma-counting for such analysis. Bevelling of the tips of the meat has made it possible to reduce to within the scheduled limits the dog-boning customary after lamination. A 60° bevel appears in first approximation to be the most appropriate for the bevelled zone to be kept within the authorized limits after lamination. Finally, the triplex-element assembly has been carried out under vacuum, as this technique makes it possible to obtain composite plates with a minimum of blisters. Author

N66-35710# Oak Ridge National Lab., Tenn.
MEASUREMENTS AND SINGLE-VELOCITY CALCULATIONS OF DIFFERENTIAL ANGULAR THERMAL-NEUTRON ALBEDOS FOR CONCRETE
R. E. Maerker and F. J. Muckenthaler Apr. 1966 29 p refs (ORNL-TM-1421; AD-635303) CFSTI: HC $2.00/MF $0.50

Single-velocity Monte Carlo calculations and measurements were performed to determine the differential angular thermal-neutron albedos for a reinforced concrete from monodirectional beams of incident thermal neutrons. Preliminary calculations using a statistical estimation technique indicate up to 50 scatterings should be followed for each neutron in order to produce good estimates of the differential albedos, and up to 100 scatterings to produce good estimates of the capture gamma-ray differential dose albedos. Deviation between experiment and calculation can be reduced to an average of 5.1% for 72 points of comparison if an anisotropic scattering law for water deduced from earlier Argonne National Laboratory measurements is assumed. Author (TAB)

N66-35720# Atomics International, Canoga Park, Calif.
THE DTF-II SHIELDING DATA LIBRARY
W. B. Green 25 May 1966 88 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11831) CFSTI: HC $3.00/MF $0.75

A new data library is available for use with the DTF-II S_N theory transport code in computing neutron fluxes in shield systems and reactor criticality. Two group structures are available: a 21-group structure with nine energy groups in the 0.41- to 14.9-MeV range (primarily for use in shielding problems) and a 16-group structure (suitable for use in criticality calculations). The epithermal data for both group structures were obtained by

group-averaging pointwise data over a typical SNAP spectrum using the GAM-II code (these calculations were performed by personnel at Oak Ridge National Laboratory). Data for the thermal range were taken from previously generated data libraries at Atomics International. A complete listing of the library data is also included. Author (NSA)

X66-35808# Du Pont de Nemours (E. I.) and Co., Aiken, S. C.
ATTACHING RIBS TO ZIRCALOY-FUEL ASSEMBLIES BY ELECTRON BEAM WELDING
Anthony S. Ferrara and Forrest F. Glasgow Feb. 1966 23 p refs
(Contract AT(07-2)-1)
(DP-996) CFSTI: HC $2.00/MF $0.50

A guidance system, jigs, and fixtures were developed for electron beam welding longitudinal ribs to either the inside or the outside of 10-foot-long, thin-walled Zircaloy-2 tubing, approximately 3 inches in diameter, or for welding ribs to the outer cladding of otherwise finished, rigid fuel elements. A demonstration run of 26 thin-walled Zircaloy-2 housing tubes indicated that the equipment and techniques were fundamentally satisfactory, and that with minor improvements the equipment would probably also be adequate for welding external ribs on fuel elements. Author (NSA)

N66-35810# Oak Ridge National Lab., Tenn.
SDC, A SHIELDING-DESIGN CALCULATION CODE FOR FUEL-HANDLING FACILITIES
E. D. Arnold and B. F. Maskewitz Mar. 1966 75 p refs
(Contract W-7405-ENG-26)
(ORNL-3041) CFSTI: HC $3.00/MF $0.75

A simplified computer code, SDC, is presented for calculating the gamma-shielding requirements for chemical processing, fabrication, or fuel-handling facilities. It is a FORTRAN code designed for the IBM 7090 computer. SDC was designed to handle 13 source geometries (point, line, disk, plane, slab, cylinder with shield at side, cylinder with shield at end, sphere, ring, rod cluster, skew line, annular cylinder with shield at side, and annular cylinder with shield at end) either unshielded or shielded by slab shields. Materials of construction for shield, cladding, or source volume may be selected from a list of 17. As many as 12 gamma-energy groups, covering an energy range of 0.10 to 10 MeV, with corresponding source strengths, may be used to describe the gamma spectrum. Integration of the basic exponential attenuation-point kernel over the various geometrics was the method chosen for calculating the uncollided gamma flux. Biological dose rate was obtained by multiplying this uncollided flux by the product of a flux-weighted buildup factor and a dose-conversion factor. NSA

N66-35811# Battelle Memorial Inst., Columbus, Ohio.
THE DIFFUSION OF FISSION PRODUCTS IN FUEL-ELEMENT CLADDING MATERIALS AND RELATED ALLOYS
James E. Howes, Jr., David L. Morrison, Edward J. Jablonowski, and Duane N. Sunderman 21 Feb. 1966 55 p refs
(Contract W-7405-ENG-92)
(BMI-1763; EURAEC-1604) CFSTI: HC $3.00/MF $0.50

Fission-product diffusion in several metal systems was studied during irradiation and in postirradiation experiments over the temperature range of 600° to 1200°C. At 600°C, nonvolume diffusion processes were evident in all of the systems examined. Above this temperature, the activation energies (Q) and frequency factors (D_0) for diffusion were considerably below those expected for normal vacancy-diffusion processes in the fcc alloys, iron-29 wt % nickel-13 wt % chromium, iron-20 wt % nickel, and iron-18 wt % chromium-8 wt % nickel, and in hexagonal-close-packed zirconium and Zircaloy-4. In the body-centered-cubic metals and alloys, beta zirconium, beta Zircaloy-4, and iron-20 wt % chromium, the fission-product diffusion occurred at nearly the same rate as self-diffusion in the same material. An apparent reduction in fission-product mobility was noted for fission-product migration in Type 304 stainless steel and Incoloy 800. Irradiation appeared to have little effect on fission-product diffusion in the 600 to 800°C temperature range within the limits of concentration studied, about 5×10^{17} fission-product recoils per cm^3. Author (NSA)

N66-35814# Los Alamos Scientific Lab., N. Mex.
RADIATION MEASUREMENTS OF THE EFFLUENT FROM THE NRX A-2 AND NRX A-3 REACTORS
R. W. Henderson and O. W. Larson 20 May 1966 51 p refs
(Contract W-7405-ENG-36)
(LA-3394-MS) CFSTI: HC $3.00/MF $0.50

Compilation of data resulting from the collection of samples of the effluent clouds from the NRX A-2 and A-3 reactors during full power operation is presented. Data are presented concerning the magnetic and isotopic composition of the airborne and ground deposition material. The environmental impact of these tests was calculated for hypothetical conditions of land use and occupancy, and these data are included. A brief description of equipment and techniques is also given. Author (NSA)

N66-35818# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
BURNUP DETERMINATION OF NUCLEAR FUELS Project Report, Oct. 1-Dec. 31, 1965
William J. Maeck, Robert M. Abernathey, and James E. Rein, ed. May 1966 28 p refs
(Contract AT(10-1)-205)
(IDO-14676) CFSTI: HC $2.00/MF $0.50

The main emphasis during this period was devoted to the development of an isotope dilution, mass spectrometric analysis method for ruthenium and the determination of the absolute thermal fission yields of stable and long lived isotopes of ruthenium for 235U. The average values, determined on two each of dissolved, standard 233U and 235U burnup capsules, are given. NSA

N66-35825# Oak Ridge National Lab., Tenn.
METALS AND CERAMICS DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING JUNE 30, 1965
Sigred Peterson, ed. Nov. 1965 345 p refs
(Contract W-7405-ENG-26)
(ORNL-3870)CFSTI: HC $7.00/MF $1.75

Summary reports are given of research associated with reactor development and support. The fundamental programs include crystal physics, deformation of crystalline solids, diffusion in solids, electron microscopy, electronic properties of metals and alloys, physical ceramic studies, physical properties, solid-state and molecular theory, spectroscopy of ionic media, structure of metals, superconducting materials, surface reactions of metals, and X-ray diffraction. Research for reactor development centered on fuel element development, high temperature materials, materials compatibility, mechanical properties, nondestructive test development, tungsten metallurgy, uranium nitride, and zirconium metallurgy. Subjects pursued under reactor development support were Army reactors program, desalination, gas-cooled reactor program, high flux isotope reactor and target development, medium power reactor experiment, molten-salt reactor, reactor evaluation, and thorium utilization. Other program activities include BONUS reactor support, metallography, and SNAP-8 and SNAP-50 corrosion studies. L.E.W.

N66-35837# Nuclear Materials and Equipment Corp., Apollo, Pa.
DEVELOPMENT AND TESTING OF PuO_2-UO_2 FAST REACTOR FUELS Progress Report, 1 Jan.-31 Mar. 1966
20 May 1966 25 p refs
(Contract AT(30-1)-3524)
(NUMEC-3524-17) CFSTI: HC $1.00/MF $0.50

The production of pellets for the EBR-II irradiation rods is continuing. The greater proportion of the coprecipitated and master blended fuel pellets have been produced. The production of the mechanically mixed fuel is underway and the necessary sintering trials continue. The apparent lack of correlation in sintering results between trial batches and production lots is most likely due to the difference in mixing techniques. Control of density is a persistent problem at the levels and limits considered necessary at this stage. Yields and materials losses encountered to date are tabulated. The metallography of UO_2-clad powder specimens heated to 1250°C for 24 hours indicates no reaction zone. The difference in PuO_2–UO_2 melting points under argon and N_2–6 vol % H_2 appears to be quite significant and details are presented. NSA

N66-35839# Nuclear Materials and Equipment Corp., Apollo, Pa.
IRRADIATION TESTING OF PuO_2–UO_2 FUELS Quarterly Progress Report, 1 Jan.–31 Mar. 1966
31 May 1966 36 p refs
(Contract AT(30-1)-3432)
(NUMEC-3432-21) CFSTI: HC $2.00/MF $0.50

Photomicrographs of irradiated PuO_2–UO_2 fuels, prepared by five different procedures, are presented and discussed. A plot of fission gas release as a function of the fuel volume showing the effects of grain growth indicates that homogeneous and heterogeneous substoichiometric fuels behave similarily. There appears to be little difference in the fission gas release from co-precipitated and substoichiometric mechanically-blended mixtures operating at the same temperature. Mechanically-blended stoichiometric oxides showed significant grain growth in comparison to the other specimens, but very little difference in the amount of fission gas released. NSA

N66-35871# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JULY 1965
Russell W. Dayton and Stan J. Paprocki 1 Aug. 1965 39 p refs
(Contract W-7405-ENG-92)
(BMI-1738) CFSTI: HC $1.00/MF $0.50

Research and development progress is reported on reactor materials and components, ceramic fuels, radioisotope and radiation applications, coated-particle fuels, fluoride volatility processes, and gas cooled reactor materials. NSA

N66-35878# Centre National de Recherches Metallurgiques, Liege (Belgium). Application of Metals Div.
A STUDY ON PLASTIC FATIGUE EMBRITTLEMENT OF REACTOR VESSEL STEELS Quarterly Report No. 8, 1 Oct.–31 Dec. 1965
[1966] 46 p Transl. into ENGLISH from French
(Contract EURATOM-005-63-12 TEEB)
(EUR-2689; EURAEC-1547) CFSTI: HC $2.00/MF $0.50

V impact strength tests were performed on ASTM A302B, Ducol W30, and Soudotenax 56 steel samples that were previously subjected to cycle plastic fatigue at 20 and 300° C. The results show that the increase in the transition temperature of samples exhibiting a crystallinity of 50% at the fracture surface is not a continuous function of the number of plastic fatigue cycles. Only a few cycles at 300° C were sufficient to cause an appreciable embrittlement of the steels. Rockwell B measurements were performed on samples that possessed a completely crystalline fracture from the Charpy test. The Rockwell B hardness maxima corresponded to the embrittlement maxima. Biaxial bend tests were performed to investigate the effects of prior strain-hardening on the fatigue life at 300° C. Two of the three steels showed an increase in their plastic fatigue properties at rupture. NSA

N66-35883# Oak Ridge National Lab., Tenn.
POINT-SET REPRESENTATION OF U-238 CROSS SECTIONS; VALUES AND A FORTRAN PROGRAM FOR COMPUTATION
J. Wallace Webster Jun. 1966 73 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1448) CFSTI: HC $2.00/MF $0.75

As part of the current effort in reactor analysis to obtain representations of cross sections as sets of values at discrete energy points rather than as sets of averaged values over broad intervals of the energy domain, a FORTRAN program is presented which computes total and capture cross section of ^{238}U at specified energy points over a resonance. The resonance parameters and the temperature are input data. Using the data on the resonance parameters given in BNL-325, Second Edition, Supplement No. 2, Vol. III (Feb. 1965), and the above program, 862 point representations were computed for the cross sections of ^{238}U at a temperature of 300°K for neutron energy less than 1000 ev. The results are presented in the form of machine printouts as well as Calcomp plots. Author (NSA)

N66-35895# Materials Research Lab., Inc., Richton Park.
FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS. DEVELOPMENT OF TEST PROCEDURES, 1 MAY 1965–1 MAY 1966
E. J. Ripling and Phillip Crosley 31 May 1966 17 p
(Contract AT(11-1)-1477)
(COO-1477-4) CFSTI: HC $1.00/MF $0.50

A tapered double cantilever beam specimen for fracture toughness testing was developed, and experimental compliance calibrations of the specimen were performed. The effect of side grooves was investigated with the testing of 7075–T651 and 2024–T351 aluminum alloys. The results indicate that the use of side grooves promotes plane strain fracturing, and that, when plane strain conditions are satisfied, measured values of fracture toughness are not affected by groove depth. A technique of alternating fatigue with increasing load testing was used for testing 4556–H321 aluminum alloy. Initiation of rapid fracture in specimens precracked in fatigue (rather than in increasing load) occurred at lower values of the crack extension force, indicating that this technique promotes plane strain fracturing. Very high loading rates were used for room temperature testing of A302-B specimens pre-cracked in fatigue. With pulse loading, crack arrests were obtained. The procedure offers the promise of yielding room temperature plane strain fracture toughness data, for fracture initiation and arrest of A302-B steel with specimens of a resonable size. Author (NSA)

N66-35899# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
ASSESSMENT OF INHOMOGENEITY OF SOLID REACTOR FUELS BY FISSION-TRACK COUNTING
A. S. Covert and W. W. Schultz Apr. 1966 13 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6556) CFSTI: HC $1.00/MF $0.50

A new method for measuring homogeneity of U and/or Th in nuclear fuels was developed. The method was applied to mixed oxide fuels. Fission tracks in insulating materials are used as the basis for the measurement. Statistical methods of testing for randomness are suggested. Author (NSA)

N66-35901# Thermo Electron Engineering Corp., Waltham, Mass.
RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS Quarterly Progress Report, Feb.–Apr. 1966

J. B. Dunlay 27 May 1966 30 p
(Contract AT(30-1)-3634)
(ALO-3634-1) CFSTI: HC $2.00/MF $0.50

The designs of the material compatibility screening and the planar thermal conductivity test assemblies were completed. Fabrication of the test assemblies was initiated. Preliminary designs of the cylindrical thermal conductivity and the edge heat loss test assemblies were established.

Author (NSA)

N66-35903# Societe Belge pour l'Industrie Nucleaire, Brussels (Belgium). Centre d'Etude de l'Energie Nucleaire.
USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS Quarterly Report No. 8, 1 Oct.-31 Dec. 1965
Feb. 1966 120 p refs Transl. into ENGLISH from the French
(Contract EURATOM-001-64-1 TRUB)
(BN-6602-02; EUR-2814; EURAEC-1593) CFSTI: HC $4.00/MF $0.75

The factors governing the selection of Incoloy 800 as cladding for UO_2–PuO_2 fuels are discussed. The development of the fabrication processes for vibratory-compacted fuel elements is described. Mechanical strength and ductility tests revealed that the ductility of the Incoloy 800 cladding was not affected by swaging. The localized heat surpluses caused by segregation of PuO_2 in the fuel elements were found to have a negligible effect on the thermal performance of the fuels. A process for separating fission products was adapted for the analysis of the burnup ratio of low-burnup fuels. Problems still exist due to the plutonium interference resulting from the inability to separate the plutonium from the fission products. Two methods were used for the theoretical interpretation of the space-time neutron distributions characteristic of subcritical lattice research with the pulsed neutron method. The first method employed spot kinetics, where it is assumed that neutron density can be separated into an amplitude function and a shape function, the first dependent on time and the second assumed independent of it. The remaining eigenvalue for neutron density is then a simple function of the effective multiplication factor of the medium in question, of the effective fraction of neutrons delayed, and of the lifetime of the prompt neutrons. The other method is based on nodal analysis where the medium is subdivided into core and reflector, for which time-dependent conservation equations are formulated. Resolution of the system gives two decay constant eigenvalues of different orders of magnitude. An experimental neutron study of the lattices formed by fuel rods from the Thetis reactor continued with an overflight of the lattices with volumetric water/oxide ratios of 2.6, 6.3, and 1.5. The 4.1 ratio lattice was then reloaded and void coefficient measurements and measurements of the effects of absorbents at the core boundary were effected. NSA

N66-36021# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
COMPARISON OF DIFFERENT METHODS FOR THE KINETICS OF AN ESSOR REACTOR TYPE
G. Forti, C. Rinaldini, and E. Vincenti Jul. 1966 22 p refs
(EUR-3051.e) CFSTI: HC $1.00/MF $0.50

With the aim of investigating the kind of representation needed in the kinetics calculation of a reactor made up of three quite different regions, like the ESSor reactor, three approaches were used: a point model method, a nodal method subdividing the reactor in three spatial regions, and a direct numerical solution of the time dependent diffusion equations. The results lead to the conclusion that, for a large category of transients, the point model is a good representation of the ESSor reactor. Author

N66-36143# Atomics International, Canoga Park, Calif.
NUCLEAR SPACE POWER SYSTEMS
R. A. Stone, ed., 1 Apr. 1961 214 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-5650) (Declassified)

This report presents a detailed description of the nuclear space power systems presently under development. In addition weight and performance estimates are given for higher power and more advanced nuclear systems employing thermoelectric, turboelectric and thermionic power conversion methods. Various aspects of reactor design are discussed with respect to inherent limitations and system requirements. Many problems which are common to all nuclear systems such as shielding, reliability, heat rejection, safety, and operational considerations are presented in some detail. Author

N66-36177# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MEASUREMENT OF NEUTRON DENSITY DISTRIBUTIONS IN MULTILAYER UNIT CELLS. II: RESULTS FOR ANNA REACTOR CELL WITH WATER, 14.0 cm LATTICE PITCH
L. Adamski, E. T. Jozefowicz, K. Jozefowicz, and A. Szechter Mar. 1966 26 p refs
(INR-698/IX-A/RP) CFSTI: HC $2.00/MF $0.50

Neutron density distribution in the Anna elementary cell with water, 14.0 cm lattice pitch, was measured using the method of spiral wire-detector. The results are given in the form of distributions of bare and subcadmium copper activities. Wide discussion of experimental errors and difficulties of the method is included. Author

N66-36179# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
ON THE CALCULATION OF ISOTOPIC CONTENTS DURING A REACTOR FUEL IRRADIATION AND REPROCESSING CYCLE
I. S. Mc Gill Jun. 1966 14 p ref
(AERE-M-1738) HMSO: 1s 9d

A calculation procedure is described yielding the isotopic concentrations at the end of the irradiation and reprocessing periods in a reactor fuel cycle. Topping up of the fuel charge with fresh fissile material is included in the calculation, which is based on the procedure for the analysis of radioactive decay chains. A STRETCH Fortran program based on the calculation procedure is described. Author

N66-36180# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
OBTAINING AN IMPERMEABLE GRAPHITE BY IMPREGNATION WITH MOLTEN METALS [OBTENTION D'UN GRAPHITE IMPERMEABLE PAR IMPREGNATION DE METAUX FONDUS]
H. Burg, F. Lanza, and G. Marengo Jun. 1966 35 p refs In FRENCH; ENGLISH summary
(EUR-2988.f) CFSTI: HC $2.00/MF $0.50

An impregnation procedure of graphite by means of fused metals (Mg, Al–Si (13%)) was studied. As liquid metals do not wet graphite, they have to be forced into the pores by means of applied pressure. Optimum temperature and pressure conditions were obtained. The impregnation value giving rise to an impervious material was determined. The comparison of the impregnation values with data obtained by means of the mercury porosimeter offers the possibility to determine the minimum pore radius filled by the fused metals. Author

N66-36191# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
POST-IRRADIATION EXAMINATION OF AN EXPERIMENTAL SEIMENS-MZFR-SEPTAFOIL BUNDLE Final Report
H. A. Knaab and R. D. Page Jul. 1965 45 p refs
(EXP-NRX-50606)

The post-irradiation examination results of an experimental Siemens MZFR Septafoil fuel bundle (1860-mm long, Zircaloy-2-clad, 11.7-mm element diameter, 0.6-wall-thickness, UO_2-fuel) are presented. It was irradiated for two months in the X-5 loop in NRX. The structural stability of the bundle and the behavior of all components were satisfactory. A relatively high pre-irradiation corrosion rate and a high hydrogen pick-up during irradiation were observed. All surfaces were covered by corrosion products with increasing thickness in flow direction. Fretting corrosion was observed at points of contact between the bundle and its surrounding flow tube. Surface marks were visible on elements and spacers at their contact areas which could not be clearly defined. Metallographic examination did not reveal penetration of the sheath. Author (NSA)

N66-36192# Atomic Energy Commission Research Establishment, Riso (Denmark).
[STUDIES IN PARTICLE PHYSICS] Progress Report, Period Ending Apr. 1965
H. Bjerrum Moeller, ed. Apr. 1965 24 p refs
(EANDC(OR)-35(L))

Collimators—development of polarizing, for neutron beams; Neutrons—polarization of, development of collimator for; Gamma Radiation—measurement of capture, using non-polarized neutrons; Crystals—structure properties of, neutron-diffraction analysis studies of; Neutron-Diffraction Analysis—of structural properties of crystals; Brass—order-disorder transformation in beta-, neutron-diffraction analysis of; Chromium—neutron scattering in, inelastic; Neutrons—scattering in chromium, inelastic; Neutrons—beta-decay half life measurements for; Reactor Experimental Facilities—pile oscillator measurements at DR-1; Research Reactors—pile oscillator measurements at DR-1. NSA

N66-36195# Production Group, United Kingdom Atomic Energy Authority, Sellafield (England).
[OPERATION AND PERFORMANCE OF WINDSCALE ADVANCED GAS COOLED REACTOR] Status Summary No. 8
20 Aug. 1965 3 p
(NP-15606)

Windscale Advanced Gas Cooled Reactor—operation and performance of, status summary; Reactor Fuel Elements—operational performance in WAGR. NSA

N66-36197# United Kingdom Atomic Energy Authority, Springfields (England).
THE DEVELOPMENT OF TECHNIQUES FOR THE NON-DESTRUCTIVE TESTING OF STAINLESS-STEEL-CLAD UO_2 FUEL PINS
J. Rooney, A. Reid, and G. A. Armstrong 10 Mar. 1965 51 p refs
(TRG-941(S))

Eddy-current, radiographic, and ultrasonic techniques developed for the inspection of the tube forming the fuel pin sheath and of the completed fuel pins are described. NSA

N66-36198# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
CANADIAN MATERIALS NEWSLETTER NO. 22
G. W. Parry Jun. 1965 41 p ref
(FD-36-22p)

Uranium (IV) Oxides—preparation of hypostoichiometric; Uranium Systems—Si-U, preparation of delta phase, procedure for; Uranium Alloys—U-Zr, preparation of epsilon phase, procedure for; NPD Reactor—fuel bundles numbers 0960, 0678, and 2048, postirradiation examination of; NRX Reactor—fuel elements, effects of boiling burnout on; Niobium Alloys—Nb-Zr, tensile properties of extruded, spray-quenched and cold-drawn pressure tubes of; Zirconium Alloys—Nb-Zr, tensile properties, effects of temperature on; Iron—corrosion by ammoniated water at 280°C and lithiated water at 315°C; Zircaloy-2—corrosion by ammoniated water at 280°C and lithiated water at 315°C; Copper—corrosion by ammoniated water at 280°C and lithiated water at 315°C; Graphite—corrosion by ammoniated water at 280°C and lithiated water at 315°C; Carbon Systems—C-Fe-Si, Meehanite, corrosion by ammoniated water at 280°C and lithiated water at 315°C; Water—corrosive effects on copper, graphite, iron, meehanite, and Zircaloy-2 at 280°C, ammoniated; Water—corrosive effects on copper, graphite, iron, meehanite, and Zircaloy-2 at 280° C, ammoniated; Water—corrosive effects on copper, graphite, iron, meehanite, and Zircaloy-2 at 315° C, lithiated; Zircaloy-2—oxidation during fuel irradiation, effects of pretreatments on; Zirconium Alloys—Nb-Zr, oxidation during fuel irradiation, effects of pretreatments on; Zircaloy-2—radioinduced swelling in U-2 Mk IV pressure tube of, fast neutron; Neutrons, Fast—effects on dimensions of U-2 Mk IV Zircaloy-2 pressure tube. NSA

N66-36268# Los Alamos Scientific Lab., N. Mex.
ADVANCED REACTOR TECHNOLOGY (ART) Quarterly Status Report, Period Ending 31 Jan. 1966
8 Mar. 1966 73 p refs
(Contract W-7405-ENG-36)
(LA-3482-MS) CFSTI: HC $3.00/MF $0.75

Further developments in construction of the Fast Reactor Core Test Facility (FRCTF) are reported. Preliminary calculations for the Molten Plutonium Burnup Experiment (MPBE) are given. The corrosive effects of molten Pu alloys on Ta and Ta-W fuel capsules are presented. The results are also presented for carburized fuel capsules. Sodium technology and other supported research to be used in conjunction with the MPRE are included. NSA

N66-36268# California Univ., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 24, Jan.-Mar. 1966
C. T. Prevo et al [1966] 14 p refs
(Contract W-7405-eng-48)
(UCRL-14881) CFSTI: HC $1.00/MF $0.50

CONTENTS:

1. TISSUE EQUIVALENCE OF LiF C. T. Prevo and J. L. Cate p 1-2 refs
2. LITHIUM-DRIFTED GERMANIUM GAMMA DETECTOR C. T. Schmidt p 3-6
3. A NOTE ON THE RESPONSE OF THE REM NEUTRON DOSIMETER TO INTERMEDIATE ENERGY NEUTRONS S. Block p 7 refs
4. CRITICALITY ANALYSIS OF LRL SHIPPING CONTAINER FOR FISSILE MATERIAL A. Lorenz and J. R. Gaskill p 8-9 refs
5. DUST REMOVAL FROM HIGH SPEED PRINTERS USING WET CYCLONE SCRUBBERS C. L. Lindeken and R. D. Taylor p 10-11 ref
6. CONDENSATION OF HIGH EXPANSION FOAM USING A CENTRIFUGAL SEPARATOR C. L. Lindeken and R. D. Taylor p 12-13 refs

N66-36269# California Univ., Livermore. Lawrence Radiation Lab.

POST-SHUTDOWN GENERATION OF PHOTONEUTRONS IN BERYLLIUM-MODERATED SYSTEMS

Thomas C. Varljen (M.S. Thesis—Calif. Univ., Berkeley, 25 Jun. 1965) 15 May 1966 51 p refs

(Contract W-7405-ENG-48)

(UCRL-14720) CFSTI: HC $3.00/MF $0.50

A calculational method was developed for the prediction of delayed photoneutron yields in infinite, homogeneous media containing beryllium and any given fissionable species and moderating material, over any desired time interval after shutdown. The results are shown to agree with existing experimental data for pure beryllium systems, and yield predictions are made for beryllium–oxide and $BeO-OyO_2$ systems. The build-up and decay of the delayed gamma activity of individual hard-gamma-emitting product nuclides during arbitrary irradiation programs is computed. A multigroup description of the resulting photon source spectrum is then utilized. Use is made of the fact that in an infinite medium the energy history of each source photon is determined strictly by interaction probabilities which are functions of energy only. The source photon number-energy distribution is modified to account for photon energy transfer by Compton scattering. The number of photoneutrons generated by the effective photon spectrum is then computed. A digital computer program was written to perform the calculations and produce graphical displays of the results. A series of problems was run to predict the photoneutron yield in systems using the delayed gamma activity from the products produced by the thermal fission of ^{235}U. The yield in photoneutrons per fission was computed for constant power irradiation programs of 15 minutes, 6 hours, and 74 hours, for infinite media of pure beryllium, beryllium-oxide, and 90% BeO–10% OyO_2 by weight, over time spans of 100 to 10^8 seconds after shutdown. Author (NSA)

N66-36273# Los Alamos Scientific Lab., N. Mex.

PIN TECHNIQUE FOR DISPLACEMENT MEASUREMENTS IN KIWI TNT

Beverly Washburn and C. E. Hudson (Edgerton, Germeshausen, and Grier, Santa Barbara, Calif.) 14 Feb. 1966 19 p

(Contract W-7405-ENG-36)

(LA-3388-MS) CFSTI: HC $1.00/MF $0.50

A pin technique used to measure relatively small, early outward displacements of the TNT reactor core and reflector cylinder components during the Kiwi Transient Nuclear Test is described. Considerations necessary to adapt this method to the environment of the reactor transient and the results are presented. An experiment to determine the times of closing of selected propellant passages using coaxial wires is also outlined. Author (NSA)

N66-36275# Argonne National Lab., Ill.

ESTIMATED TEMPERATURES OF EBR-II FUEL CYCLE FACILITY SHIELDING WINDOWS AT GAMMA RADIATION LEVEL OF 3.5×10^5 rad per hour

T. W. Eckels and L. F. Coleman Feb. 1966 34 p refs

(Contract W-31-109-ENG-38)

(ANL-6853) CFSTI: HC $2.00/MF $0.50

Calculations were made of the transient and steady-state temperatures that may be expected to occur in EBR-II Fuel Cycle Facility shielding windows subjected to gamma radiation. The limiting assumptions are stated, and observations were made of the temperature effects of installing a 1/4-in.-thick glass cover plate over the exposed surface of the heavy glass slab that is at the hot side of each window. The window temperature that will result from a proposed schedule of opening and closing a 6-in.-thick steel shielding shutter is also discussed. Author (NSA)

N66-36279# Argonne National Lab., Ill.

CHEMICAL ENGINEERING DIVISION RESEARCH HIGHLIGHTS, MAY 1965–APRIL 1966

R. C. Vogel, M. Levenson, J. H. Schraidt, and J. Royal [1966] 242 p refs

(Contract W-31-109-ENG-38)

(ANL-7175) CFSTI: HC $6.00/MF $1.25

Work devoted to analytical support of chemical engineering developments are summarized for the fields of reactor safety, energy conversion, nuclear constants, and related topics. Data are included on: elemental chemical analysis, atomic absorption spectrometry, X-ray spectroscopy, X-ray diffraction, electron probe microscopy, gas analysis, determination of burnup in fast reactors, ceramic fuel preparation, calorimetric determination of high-temperature materials thermodynamic properties, liquid Na chemistry, metal-water reactions related to water-cooled reactor accidents, reactions of fuel and cladding materials with liquid Na, transient heat transfer, fuel migration and segregation in mixed U–Pu compounds, properties of fast reactor materials, reactions of Na with air, physical–chemical aspects of regenerative emf cells, capture cross sections of reactor structural materials, radiative capture cross sections of ^{98}Mo, ^{89}Y, ^{139}La, ^{141}Pr, ^{176}Yb, and ^{175}Lu. R.U.

N66-36281# Battelle–Northwest, Richland, Wash. Pacific Northwest Lab.

CONTAINMENT SYSTEMS EXPERIMENT. PART III: MATHEMATICAL MODELS OF PRESSURE-TEMPERATURE TRANSIENTS

B. M. Johnson May 1966 154 p refs

(Contract AT(45-1)-1830)

(BNWL-233) CFSTI: HC $5.00/MF $1.00

The current status of theoretical models depicting loss of coolant accidents is described. Critical two-phase flow, system blowdown models, and containment models are discussed. Further theoretical development is reported on the energy balance equations, blowdown flow rates, core pressure drop, heat transfer, and dry well downcomer flow. An evaluation of the primary system model, dry well model, wet wall model, and dry containment model was made. NSA

N66-36346# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

SHORT DURATION IRRADIATION BEHAVIOR OF UO_2 DOPED WITH 1/4 mol% Nb_2O_5 OR 1/4 mol% Y_2O_3

A. S. Bain May 1966 23 p refs

(AECL-2581) CFSTI: HC $1.00/MF $0.50

Twelve specimens were manufactured for short duration irradiations in the Hydraulic Rabbit facility of the NRX reactor at Chalk River. The irradiation was to test the UO_2 and to compare its performance with UO_2 doped with 1/4 mol% Nb_2O_5 or 1/4 mol% Y_2O_3. The irradiation behavior of the pure UO_2 was similar to that of AECL UO_2. The addition of 1/4 mol% Nb_2O_5 or Y_2O_3 did not improve the irradiation performance. Author

N66-36365# European Atomic Energy Community, Brussels (Belgium).

PROCEEDINGS OF THE CONFERENCE "FUEL CYCLES OF HIGH TEMPERATURE GAS-COOLED REACTORS"

D. Tytgat, ed. May 1965 674 p refs Conf. held at Brussels, 10–11 Jun. 1965

(EUR-2780-e) CFSTI: HC $9.73/MF $3.25

CONTENTS:

1. THE COST OF COATED PARTICLE FUEL FOR A HIGH TEMPERATURE REACTOR PROGRAMME R. A. U. Huddle, M. S. T. Price, M. Houdaille, and W. G. Popp (Atomic Energy Estab., Winfrith, England) p 1–26 refs

2. FABRICATION VARIABLES, PERFORMANCE AND COST CONSIDERATIONS FOR HTGR COATED-PARTICLE FUELS W. O. Harms and D. B. Trauger (Oak Ridge Natl. Lab.) p 27–49 refs

3. FUEL DEVELOPMENT FOR THTR G. Spener, M. Hrovat, and L. Rachor (Nuklear-Chemie und -Met., G.m.b.H., Wolfgang Bei Hanau, W. Ger.) p 51–60

4. FUEL FABRICATION TECHNIQUES FOR HIGH TEMPERATURE GAS-COOLED REACTOR FUELS D. V. Ragone (Gen. Dyn., San Diego, Calif.) p 61–70 refs

5. DESIGN AND FABRICATION OF THE ARBEITSGEME INSCHAFT VERSUCHS-REAKTOR (AVR) INJECTION-MOLDED FUEL ELEMENT W. P. Eatherly and M. N. Burkett (Union Carbide Corp., Lawrenceburg, Tenn.) p 71–81 refs

6. FABRICATION METHODS AND COSTS OF FUEL ELEMENTS D. Tytgat and P. Caprioglio p 83–120

7. STUDIES ON THE REPROCESSING AND FABRICATION OF HTGR FUELS IN THE OECD DRAGON PROJECT G. W. Horsley, L. A. Podo, and R. C. Wood (Atomic Energy Estab., Winfrith, England) p 121–144 refs

8. BURN-LEACH PROCESSES FOR GRAPHITE-BASE REACTOR FUELS CONTAINING CARBON-COATED CARBIDE OR OXIDE PARTICLES E. L. Nicholson, L. M. Ferris, and J. T. Roberts (Oak Ridge Natl. Lab.) p 145–166 refs

9. REFABRICATION TECHNOLOGY AND COSTS FOR HIGH-TEMPERATURE GAS-COOLED REACTOR FUELS A. L. Lotts, D. A. Douglas, Jr., and R. L. Philloton (Oak Ridge Natl. Lab.) p 167–197 refs

10. SOME POSSIBILITIES OF AQUEOUS PROCESSING OF GRAPHITE-CARBIDE FUEL ELEMENTS E. Lopez-Menchero, G. Vermeulen, and E. Detilleux (European Co. for the Chem. Process. of Irradiated Fuels, Mol, Belgium) p 199–238 refs

11. REPROCESSING OF NUCLEAR FUELS BY FLUORIDE VOLATILIZATION WITH SULFUR HEXAFLUORIDE O. Knacke, M. Laser, E. Merz, and H. J. Riedel (Arbeitsgruppe Inst. fur Chem. Technol.) p 239–243

12. HEAD-END TREATMENT FOR THE REPROCESSING OF HIGH TEMPERATURE CARBIDE-GRAPHITE FUELS H. Zust, H. R. Von Gunten, and P. Baertschi (Eidgenoess. Inst. fuer Reaktorforschung) p 245–258 refs

13. SOME ASPECTS OF VOLATILITY PROCESSES FOR REACTOR FUEL ELEMENTS CONTAINING CARBON G. Pierini and J. Schmets (Centre d'etude de l'Energie Nucl.) p 259–268 refs

14. PREPARATION OF URANIUM DIOXIDE AND CARBIDE PARTICLES BY SOL-GEL METHODS G. Cogliati, R. Lanz, and E. Mezi (Comitato Nazl. per l'Energia Nucl., Casaccia, Italy) p 269–274 refs

15. BASIC STUDIES RELATED TO THE DEVELOPMENT OF THE SOL-GEL PROCESS Th. Van Der Plas, A. J. Noothout, and M. E. A. Hermans (N. V. Kema) p 275–288 refs

16. REPROCESSING AND REFABRICATION METHODS AND COSTS M. Zifferero (Comitato Nazl. per l'Energia Nucl., Rome, Italy) and P. Caprioglio p 289–323

17. URANIUM-235/THORIUM FUEL CYCLES IN GRAPHITE MODERATED SYSTEMS J. H. Blomstrand, J. Schlosser, H. Bruneder, U. Nyffenegger, and G. Graziani (Atomic Energy Estab., Winfrith, England) p 325–355 refs

18. FUEL-CYCLE COST COMPARISONS FOR HIGH-TEMPERATURE GAS-COOLED REACTOR FUELS R. S. Carlsmith, C. M. Podeweltz, and W. E. Thomas (Oak Ridge Natl. Lab.) p 357–369 refs

19. URANIUM 235 FUELED THERMAL HIGH TEMPERATURE REACTOR WITH URANIUM 233 IN EQUILIBRIUM STATE WITH THORIUM 232 AS THE FERTILE SPECIES S. Brandes (Kernforschungsanlage) p 371–388 refs

20. FUEL CYCLES OF THE THORIUM-HOCH-TEMPERATUR-REAKTOR THTR W. Giesser (Brown Boveri/Krupp Reactorbau G.m.b.H.) p 389–397

21. BREEDING IN PEBBLE-BED REACTORS H. Dreisvogt and R. Schulten (Tech. Hochschule Aachen, W. Ger.) p 399–412 refs

22. FUTURE FUEL REQUIREMENTS FOR ATOMIC POWER PLANTS K. Wagemann (Kernforschungsanlage) p 413–445 refs

23. HTGR FUEL CYCLE ASSESSMENT STUDIES H. B. Stewart, S. Jaye, and R. C. Traylor (Gen. Dyn., San Diego, Calif.) p 447–476 refs

24. RANGE OF BURN-UPS AND CONVERSION FACTORS ECONOMIC ASSESSMENT H. Schmidt (Brown Boveri/Krupp Reactorbau G.m.b.H.) and P. Caprioglio p 477–518

25. PLUTONIUM FUEL CYCLE STUDIES FOR A LARGE HIGH TEMPERATURE GRAPHITE MODERATED REACTOR H. Bruneder and P. Haubert (Atomic Energy Estab., Winfrith, England) p 519–549

26. FUEL CYCLES FOR HIGH-TEMPERATURE GAS-COOLED REACTORS UTILIZING PLUTONIUM R. S. Carlsmith and W. E. Thomas (Oak Ridge Natl. Lab.) p 551–557 ref

27. A REVIEW OF THE STUDIES MADE ON THE UTILISATION OF PLUTONIUM IN THE HIGH TEMPERATURE REACTOR C. P. Gratton (Atomic Energy Estab., Winfrith, England) p 559–566

28. SOME ASPECTS OF THE USE OF PU IN HIGH-TEMPERATURE REACTORS L. Massimo (Euratom, Ispra, Italy) p 567–582 refs

29. THE USE OF LOW-ENRICHMENT URANIUM AND PLUTONIUM IN THE HTGR S. Jaye, P. U. Fischer, and D. H. Lee, Jr. (Gen. Dyn., San Diego, Calif.) p 583–600 refs

30. USE OF PLUTONIUM AS INITIAL FISSILE INVESTMENT AND/OR AS MAKE-UP FUEL C. P. Gratton (Atomic Energy Estab., Winfrith, England) and P. Caprioglio p 601–631

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-35362# Brown Univ., Providence, R. I.

WAVES IN MATERIALS WITH MEMORY. V: ON THE AMPLITUDE OF ACCELERATION WAVES AND MILD DISCONTINUITIES

Bernard D. Coleman, James M. Greenberg, and Morton E. Gurtin 4 Feb. 1966 56 p refs

(Contract Nonr-562(40))

(TR-9; AD-635463) CFSTI: HC $3.00/MF $0.50

This paper studies one-dimensional acceleration waves and higher-order waves in general nonlinear materials with memory. Explicit expressions are derived for the time-dependence of the amplitude of such waves without assuming the material ahead of the waves to be undistorted or homogeneous. Author (TAB)

N66-35526# Pennsylvania State Univ., University Park. Dept. of Physics.

[OPTICAL PHENOMENA IN LIQUID AND GASEOUS MEDIA] Technical Report, 1 Oct. 1963 – 31 Dec. 1965

D. H. Rank et al [1965] 126 p refs
(Contract Nonr-656(12))
(AD-626808) CFSTI: HC $4.00/MF $0.75

CONTENTS:

1. ABUNDANCE OF METHANE IN THE EARTH'S ATMOSPHERE U. Fink, D. H. Rank, and T.A. Wiggins 10 p refs (See N66-35527 21-13)

2. INFRARED ABSORPTION SPECTRA OF ISOTOPIC DIMERIC HYDROGEN CHLORIDE MOLECULES D. H. Rank, W. A. Glickman, and T. A. Wiggins 13 p refs (See N66-35528 21-06)

3. BRILLOUIN SPECTRA OF LIQUIDS USING He-Ne LASERS D. H. Rank, E. M. Kiess, U. Fink, and T. A. Wiggins 13 p refs (See N66-35529 21-16)

4. STIMULATED BRILLOUIN SCATTERING IN LIQUIDS A. H. Guenther (AFSC), T. A. Wiggins, R. V. Wick, and D. H. Rank 10 p refs (See N66-35530 21-16)

5. LASER INDUCED BREAKDOWN IN OXYGEN GAS AT HIGH PRESSURE A. H. Guenther (AFSC), T. A. Wiggins, R. V. Wick, and D. H. Rank 15 p refs (See N66-35531 21-16)

6. STIMULATED RAMAN EFFECT IN SOME TETRAHEDRAL MOLECULES D. H. Rank, R. V. Wick, and T. A. Wiggins 12 p refs (See N66-35532 21-23)

7. STIMULATED BRILLOUIN EFFECT IN HIGH PRESSURE GASES A. H. Guenther (AFSC), D. H. Rank, T. A. Wiggins, R. V. Wick, and D. P. Estman 12 p refs (See N66-35533 21-23)

8. BRILLOUIN SPECTRA OF VISCOUS LIQUIDS D. H. Rank, E. M. Kiess, and U. Fink 24 p refs (See N66-35534 21-23)

9. THRESHOLD FOR STIMULATED RAMAN SPECTRA R. V. Wick, T. A. Wiggins, and D. H. Rank 4 p refs (See N66-35535 21-23)

10. CENTER OF DISPERSION FORCES IN HCl INTERACTING WITH RARE GAS ATOMS R. M. Herman 22 p refs (See N66-35536 21-06)

N66-35532# Pennsylvania State Univ., University Park. Dept. of Physics.

STIMULATED RAMAN EFFECT IN SOME TETRAHEDRAL MOLECULES

D. H. Rank, R. V. Wick, and T. A. Wiggins *In its* [Opt. Phenomena in Liquid and Gaseous Media] [1965] 12 p refs (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

Stimulated Raman spectra have been excited in liquid Sn Cl_4 and in methane gas making use of a medium high power ruby laser. The spectra have been photographed by means of a high resolution grating spectrograph. The Δv value $\simeq v \cdot 1$ for methane was found to be 2916.605 cm-1 ± 0.012 cm-1. No detectable pressure shift was observed over a range of gas densities from 3 to 12 amagat. The stimulated Raman lines in methane are very sharp and only slightly broader than the laser line. In Sn Cl_4 the first stokes line consists of only a single component instead of the expected isotopic triplet. The half intensity width of this line was found to be 0.5 cm^{-1}. At least 0.15 cm^{-1} of this line width must be due to the stimulated Brillouin doublet since the threshold is lower for the stimulated Brillouin effect than for the stimulated Raman effect. The stimulated Brillouin effect was observed with a Fabry Perot etalon. Measurements of the Fabry Perot patterns gave a value of 840 meters per second for the velocity of sound in Sn Cl_4 at 27°C. Author

N66-35533# Pennsylvania State Univ., University Park. Dept. of Physics.

STIMULATED BRILLOUIN EFFECT IN HIGH PRESSURE GASES

D. H. Rank, T. A. Wiggins, R. V. Wick, D. P. Eastman, and A. H. Guenther (AFSC, Kirtland AFB, N. Mex.) *In its* [Opt. Phenomena in Liquid and Gaseous Media] [1965] 12 p refs Prepared in cooperation with AFSC, Kirtland AFB (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

Stimulated Brillouin scattering in gaseous nitrogen, methane and carbon dioxide has been observed using a giant pulse laser and employing gas densities from 19 to 385 amagat. Stimulated Brillouin scattering was also observed in carbon dioxide liquid at 26°C and through the transition temperature. The density threshold below which no Brillouin scattering was observed was 56 amagat for nitrogen, 19 amagat for methane, 350 amagat for gaseous carbon dioxide and 385 amagat for liquid carbon dioxide. The veloxity of sound in each case increases markedly with increasing pressure. The velocity of sound extrapolated to 1 amagat density for nitrogen and methane agrees sensibly with the isothermal velocity. There is some evidence to indicate an amplitude dependence on the measured velocities. Author

N66-35534# Pennsylvania State Univ., University Park. Dept. of Physics.

BRILLOUIN SPECTRA OF VISCOUS LIQUIDS

D. H. Rank, Edward M. Kiess, and Uwe Fink *In its* [Opt. Phenomena in Liquid and Gaseous Media] [1965] 24 p refs (See N66-35526 21-23) CFSTI: HC $4.00/MF $0.75

The behavior of the hypersonic Debye waves has been investigated in three viscous liquids by means of the Brillouin effect. The three liquids investigated, glycerin, ethylene glycol and normal octyl alcohol, all give the Landau-Placzek ratio of $I_c/2I_B = \gamma - 1$ at sufficiently high temperature so that viscosity has a negligible effect. It is found that the $I_c/2I_B$ ratio is a linear function of viscosity for viscosities below a few poises. In glycerin however measurements were made for a viscosity as high as 10^3 poises and it was found that the attenuation of the Debye waves increased very slowly when the viscosity was increased from 2.5 poises to 10^3 poises. Author

N66-35535# Pennsylvania State Univ., University Park. Dept. of Physics.

THRESHOLD FOR STIMULATED RAMAN SPECTRA

R. V. Wick, T. A. Wiggins, and D. H. Rank *In its* [Opt. Phenomena in Liquid and Gaseous Media] [1965] 4 p refs (see N66-35526 21-23

The effect of power and path length on the threshold for stimulated Raman production was investigated. A giant pulse Korad ruby laser system was used, producing an energy of 0.5 joules in 10 nanoseconds in a single mode with a total beam divergence of 6 milliradians. The stimulated Raman spectra of CH_4 and H_2 were observed using 6, 20, and 100 cm length gas cells. The independence of gain with focal length was verified using a 6 cm cell focusing the light in the cell symetrically with a 5 cm lens and in a 100 cm cell focusing with a 50 cm lens. In both cases the 2nd anti-Stokes lines vanished for absolute pressures less than 55 lbs/sq in. In a 20 cm cell, the pressure threshold for the 1st anti-Stokes line of methane with a 25 cm lens was 70 lbs/sq in. absolute. The pressure threshold for the same cell and power but with a 50 cm lens was calculated to be 170 lbs/sq in. The threshold was found to be 180 lbs/sq in. Using a 50 cm lens, the threshold for an absolute pressure of 715 lbs/sq in. was determined by moving a 6 cm cell along the beam away from the focus until the green anti-Stokes line vanished. The line was not observed for pressures below 260 lbs/sq in. This was verified by observing that the green anti-Stokes line vanished at 215 lbs/sq in. in a 20 cm cell placed 25 cm from the focus of a 50 cm lens. R.N.A.

N66-35606# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE THEORY OF RAMAN SCATTERING OF LIGHT BY A MOLECULE

K. Rebane and T. Rebane 18 Feb. 1966 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz-Mat. i Tekhn. Nauk (Baku), v. 12, no. 3, 1963 p 227–237
(FTD-MT-65-225; AD-634811) CFSTI: HC $1.00/MF $0.50

The intensity of the Raman scattering by molecular oscillations is calculated on the basis of the adiabatic approximation. The oscillations are described in terms of harmonic oscillators whose equilibrium positions are displaced with the change of the electronic state of the molecule, but whose frequencies remain unchanged. For the solution of the corresponding quantum mechanical second order perturbation theory problem a new method is applied, permitting to sum up all intermediary states. Also some general problems connected with the second order perturbation theory are discussed, as the relation of such problems with Green's functions, and Green's function for the harmonic oscillator's stationary Schrodinger equation is obtained. Lastly, some sum rules for the second order perturbation theory matrix elements are derived.
Author (TAB)

N66-35781*# Consultants and Designers, Inc., Arlington, Va.
CORRECTIONS FOR LINE-OF-SIGHT VELOCITIES ON ACCOUNT OF THE DAILY ROTATION AND ANNUAL REVOLUTION OF THE EARTH DURING SOLAR OBSERVATIONS [O POPRAVKAKH LUCHEVYKH SKOROSTEY ZA SCHET SUTOCHNOGO VRASHCHENIYA I GODICHNOGO OBRASHCHENIA ZEMLI PRI NABLYUDENIYAKH SOLNTSA]
P. Kh. Salman-zade 24 Mar. 1966 14 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), No. 1, Ser. 1, 1966 p 166–171
(Contract NAS5-9299)
(NASA-CR-77702; ST-SPHA-10461) CFSTI: HC $1.00/MF $0.50 CSCL 20F

The question of line-of-sight velocity corrections for the relative motion of the observer is considered. A calculation method is proposed and an example of complete calculations is given for a single case. Author

N66-35782*# Consultants and Designers, Inc., Arlington, Va.
DEPENDENCE OF THE OPTICAL CONTINUOUS SPECTRUM OF QUASARS ON THEIR RED-SHIFT [ZAVISIMOST' OPTICHESKOGO NEPRERYVNOGO SPEKTRA KVAZAROV OT IKH KRASNOGO SMESHCHENIYA]
N. S. Kardashev and B. V. Komberg 14 Apr. 1966 10 p refs Transl. into ENGLISH from Astron. Tsirkuliar Akad. Nauk SSSR (Kazan), no. 357, 25 Feb. 1966
(Contract NAS5-9299)
(NASA-CR-77681; ST-QSS-PHM-10475) CFSTI: HC $1.00/MF $0.50 CSCL 20F

The determination of the dependence of the optical continuous spectrum of QSS (quasistellar sources) on their red-shift is based on data of the three-color photometry (UBV). It is first established for QSS with known red-shifts, revealing an absorption "step" in QSS spectra. Preliminary estimates of red-shifts are then made for some of the unidentified QSS. However, it is not yet clear what matter is responsible for absorption in intergalactic medium. For further corroboration of the conclusions the authors recommend new identifications of quasars and their m-c-photometry, concentrating the research in the region (2250±150) Å for direct detection of the absorption "step". Author

N66-36011# Southwest Research Inst., San Antonio, Tex. Planning Council.
DETERMINATION OF SURFACE TEMPERATURE AND EMISSIVITY Final Report
E. Jack Baker, Jr. (Thesis) 13 May 1966 90 p refs

Using Planck's Radiation Law, optical measurements at finite wavelengths, and an assumption as to the emissivity of the material being viewed, a method is developed whereby multicolor pyrometry can be used to determine not only the surface temperature but also the spectral emissivity of the surface of incandescent materials. Specifically, it is shown that the spectral emissivity can be described by a Taylor series truncated in the n^{th} degree of λ when n+2 intensity measurements are made at n+2 discrete wavelengths. Developed in detail is a computer program to calculate the surface temperature and spectral emissivity when given only the intensity measurements at four discrete wavelengths. Also discussed in the thesis are two experimental arrangements with instrumentation required to make the necessary optical measurements. In one of the cases the measurements are made over a narrow wavelength band rather than at a discrete wavelength, therefore a modification of the analysis for the experimental case is described. Author

N66-36037# Massachusetts Inst. of Tech., Cambridge.
BRILLOUIN SCATTERING IN LIQUIDS
Theodore Teruo Saito (M.S. Thesis) Jun. 1966 61 p refs
(Contracts DA-31-124-ARO(D)-425; ARPA SD-90)
(AD-635260) CFSTI: HC $3.00/MF $0.75

Light scattered from fluctuations caused by thermally excited sound waves, known as Brillouin scattered light, contains information about the velocity and lifetimes of the sound waves. A study was conducted using a frequency stabilized single mode helium–neon laser with .1 mw of output. Conical optics were used to gather the light. A detailed discussion of the conical optics is included, with attention given to the light gathering ability of the conical-optics. Results of the measured velocity and lifetimes show no dispersion of the velocity or attenuation for acetone and water. The frequency dispersion of the velocity and the lifetimes for toluene are reported. It is believed that the light scattered from carbon tetrachloride contains a portion scattered from a second damped mode due to a thermal relaxation in the liquid. Until the spectrum of this light can be determined, accurate measurements of the velocity and lifetimes in carbon tetrachloride cannot be made. Author (TAB)

N66-36134*# National Aeronautics and Space Administration, Washington, D. C.
COMPUTATION OF LIGHT AND ELECTRIC PARAMETERS OF GAS DISCHARGE XENON, DIRECT CURRENT LAMPS [RASCHET SVETOVYKH I ELEKTRICHESKIKH PARAMETROV GAZORAZRYADNYKH KSENONOVYKH LAMP POSTOYANNOGO TOKA]
R. Ye. Rovinskiy Aug. 1966 20 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), no. 8, 1958 p 5–10
(NASA-TT-F-10268) CFSTI: HC $1.00/MF $0.50 CSCL 20F

The results derived from studying the discharge in spherical ultrahigh pressure xenon lamps having a direct current are discussed. Brightness distribution along the discharge axis, dependence of brightness on power and distance between electrodes, and the volt ampere characteristics of xenon lamps are investigated. Author

N66-36170# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF NON LINEAR OPTICS [CONTRIBUTION A L'ETUDE DES NON LINEARITES OPTIQUES]
Jacques Ducuing Serv. de Doc. Sci. et Tech. de l'Armement, 1966 106 p refs In FRENCH
(NT-151) CFSTI: HC $4.00/MF $0.75

Optical nonlinearities, energy transfer between optical waves, nonlinear reflection, and fluctuations in luminous wave interactions are studied. It is shown that the amplitude of the interaction depends on initial conditions and on the degree of adaption of the phase velocity. Special

studies are made on phase velocities adapted (conservation of the kinetic moment), the creation of harmonic waves, and parametric amplification. A theoretical and experimental study of the laws of nonlinear reflection is also reported, and verification is made of the laws governing intensity, polarization and the propagation direction of the reflected harmonic wave to measure nonlinearities in absorbant crystals. Investigated is the influence of the coherence of sources on the production of microfrequencies, and on the resultant product of optical interactions, with particular attention to harmonic waves. Transl. by R. Ll.

N66-36219# Radiation, Inc., Melbourne, Fla.
ON THE STORED ENERGY OF PLANAR APERTURES Scientific Report No. 3
Donald R. Rhodes 20 May 1966 28 p refs
(Contract AF 19(628)-4007)
(AFCRL-66-407; AD-635534) CFSTI: HC $2.00/MF $0.50

The volume integrals in the complex Poynting theorem are usually assumed to represent stored magnetic and electric energy. But for a planar aperture radiating into a lossless homogeneous medium it is shown that the only physically observable part of the volume integrals is twice that produced in the invisible region of the pattern space factor by those field components that vanish in the plane outside of the aperture. The new formulas for stored magnetic and electric energy of planar apertures are used to make the first known test of the widely held assumption that the reciprocal relationship between Q and band-width of non-radiating systems applies also to radiating systems. By direct computation of Q and of bandwidth independently it is shown that the reciprocal relationship does hold for the test case treated (the planar dipole). Author (TAB)

N66-36242# Itek Corp., Lexington, Mass.
STUDY OF IMAGE-EVALUATION TECHNIQUES Interim Engineering Report No. 11, 15 Jan.–15 Apr. 1965
[1965] 77 p refs
(Contract AF 33(657)-9158)
(Itek-65-9048-12; AD-615648) CFSTI: HC $3.00/MF $0.75

Evaluations of the transfer function and auxiliary diffraction functions for an actual optical system are presented, particularly with regard to high acuity optical systems. Some aspects of image evaluation via the diffraction theory are discussed through calculations of diffraction functions for third-order spherical aberration. Many diffraction problems are solved by application of sampling theory concepts to the optical diffraction theory. The dangers inherent in optimum balancing techniques which arbitrarily force the third-order aberrations to vanish are discussed. Computation of the encircled energy for systems with annular apertures is outlined, and a new method of determining the optical transfer function directly from the edge spread function by employing the sampling theory is described. A new mathematical method of calculating the transfer function of an optical system in the presence of off-axis aberrations is included in addition to a discussion of the use of the variance of the wavefront as a merit function in lens design. S.P.

N66-36250# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY NO. 339: PEKING SYMPOSIUM ON SCIENCE
Shigeru Machida, Kengo Ariyama, Migi Morida, and Shinobu Nagada 26 Aug. 1966 22 p Transl. into ENGLISH from Soryusiron Kenkyu (Kyoto), Separate Issue, Aug. 1965 p 18–36 Symp. held 21–31 Aug. 1964
(JPRS-37256; TT-66-33685) CFSTI: $1.00

Described are the activities and presentations of scientists attending the Peking Symposium on science during August, 1964. A study on properties of charged hyperons and hyperfragments emitted from interactions of negative K mesons with nuclear emulsion dealt with the results of 1985 star observations; the author concluded that the spin of ϵ-hyperon is greater than one half, that a parity doublet of the ϵ-hyperon exists, and that there was parity nonconservation in the ϵ-decay. A study of the Regge behavior for a highly singular potential and for a class of nonlocal potentials showed the existence of an infinite number of poles within a narrow angle in the neighborhood of the imaginary axis. A paper on the octet theory of SU_3 and the classification of strongly interacting particles used the assumptions that: (1) nonlinearity in isospin T and hypercharge Y of the first order mass formula is independent of the spin-parities of unitary multiplets; (2) nine particles are grouped into representation of $M_8 = M_8 + M_1$ in octet-singlet mixing, and (3) that two sets of unitary multiplets seen to exist for each value of spin-parity. Also reported was research on secondary particle measuring methods, neutron spectroscopy, etc. G.G.

N66-36254# Eidgenossisches Technische Hochschule, Zurich (Switzerland).
DISTORTION OF ABSORPTION BANDS IN MICROWAVE SPECTROGRAPHS WITH STARK MODULATION. MICROWAVE SPECTRUM OF AZULENES [VERZERRUNGEN VON ABSORPTIONSBANDEN IN MIKROWELLENSPEKTROGRAPHEN MIT STARK-MODULATION. MIKROWELLENSPEKTRUM VON AZULEN]
Hans-Jakob Tobler (Ph.D. Thesis) 1965 47 p refs In GERMAN
(Rept.-3663) CFSTI: HC $2.00/MF $0.50

Electric field inhomogenuities in absorption bands of microwave spectrographs with Stark modulation were investigated theoretically. Calculations on electric field fluctuations between an electrode and the walls of a wave guide showed that an X-band waveguide with inner dimensions of 0.9"×0.4" produced considerable line distortions, and an X-band waveguide with 1.8"×0.4" inner dimensions equaled practically a parallel plate spectrograph. Microwave studies on azulenes by phase stabilized Stark spectrograph identified strong rotational changes between 7.9 and 12.6 kMHz at the vibrational ground state. Computer evaluation of the observed vibrational spectra confirmed the planar structure and C_{2v} symmetry of azulen molecules, and established the azulen dipole moment for rotational changes to 0.808±0.007 Debye. Q transitions up to J=40 were used to investigate the centrifugal distortions and to describe these effects by one parameter representation. Transl. by G.G.

N66-36413*# Innsbruck Univ. (Austria).
APPLICATIONS IN PHYSICS
A. Schett and J. Weil *In its* Soln. of Ordinary Differential Equations by Means of Lie Ser. Aug. 1966 p 57–62 refs
(See N66-36409 21-19) CFSTI: HC $3.00/MF $1.00

The general linear homogenous second order differential equation, which is the most general type of equation containing all 33 equations resulting from a separation of the Helmholtz equation in 11 coordinate systems, is applied to various physics problems. To illustrate an example from rigid body mechanics an equation of motion of a plane mathematical pendulum in the case of suspensory point vibrating in vertical direction according to the law is considered. Another problem from electricity, which is described by a circuital equation, is solved with the formalism. Lie methods are also considered in the motion of a pendulum for application to the problem of gravity gradient stabilization of artifical satellites; a

description of the motion of particles in a strongly focusing synchrotron is given by Mathieu equations; and Lie series are physically applied to the problem of the heavy asymmetrical top (gyroscope). L.E.W.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-35363# Illinois Univ., Urbana. Dept. of Physics.
REMARKS ON THE EQUAL-TIME COMMUTATOR OF AXIAL-VECTOR CURRENT COMPONENTS
Klaus Dietz [1966] 16 p refs
(Contract Nonr-1834(05))
(AD-635060) CFSTI: HC $1.00/MF $0.50

The matrix element of the equal-time commutator of the axial-vector current and its fourth component between one-nucleon states of the same momentum is investigated on the basis of very general principles. The dependence on the pion 4-momentum of Adler–Weisberger type relations for the renormalization of the axial-vector coupling constant is examined. Furthermore, the connection of Schwinger terms antisymmetric in the isospin indices with subtractions in the involved scattering amplitudes is shown. Author (TAB)

N66-35419# Regional Engineering College, Durgapur (India). Dept. of Physics.
THE DIRECT PRODUCTION OF ELECTRON PARIS BY MUONS IN MEDIUM AND LOW Z ELEMENTS
A. K. Das and M. S. Sinha *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 368–378 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Direct production of electron pairs in carbon, aluminum, and copper targets of thicknesses 0.06, 0.14, and 0.44 radiation units, respectively, was studied with two multiplate cloud chambers with muons of mean energy 6 Gev and minimum energy 0.8 Gev. The two cloud chambers were operated simultaneously and triggered by a four-fold coincidence system. Showers of two or more electrons associated with each outgoing muon from the targets were selected, and the energy transfer in each event was estimated. The cross sections as determined experimentally were corrected for double knock-on and other possible processes and compared with the theoretical cross section for direct pair production. The experimental values of d.p.p. cross sections for carbon, aluminum, and copper show good agreement with the theory in the region of energy transfers (10 + 60), (60 + 200), and (200 + 500) Mev. The data also exhibit the expected Z-dependence of the cross section, and an increase of the cross section with muon energies as predicted by theory. Author

N66-35420# Tata Inst. of Fundamental Research, Bombay (India).
THE K.G.F. NEUTRINO EXPERIMENT
K. Hinotani (Osaka City Univ.), D. R. Creed (Durham Univ.), C. V. Achar, M. G. K. Menon, V. S. Narasimhan et al *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 379–386 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Two telescopes designed for detection of muons produced by neutrinos have been set up at a depth of 7500 m.w.e. in the Kolar Gold Fields in India. During an operation period of 8000 hours 16 events were recorded, out of which 5 or 6 are estimated as due to neutrino interactions; the rest are attributed to muons produced in the earth's atmosphere. One of the events is attributed to a non-elastic neutrino interaction. The observed results are compared with theoretically expected number of interactions. Author

N66-35421# Tata Inst. of Fundamental Research, Bombay (India).
PARTICLE PHYSICS—A SURVEY
B. M. Udgaonkar *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 440–458 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A general summary is presented of developments in particle physics in order to present an overview of current state-of-the art and to discover future trends. The validity of the various conservation laws in strong, electromagnetic, and weak interactions is considered. The increase in cross section resonances or bumps has given rise to investigations of higher symmetries and the understanding of these symmetries in terms of bootstrap ideas. Phenomena related to Regge poles are discussed in relation to high energy experiments on charge exchange scattering and certain production processes. M.W.R.

N66-35422# Saha Inst. of Nuclear Physics, Calcutta (India).
POSITIVE PARITY MESONIC STATES AND UNITARY SYMMETRY
B. Dutta Roy and S. Baba Pundari *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 522–528 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The only physically realized meson SU(6)-supermultiplet (the 35-plet of pseudoscalars and vectors) is not amenable to an application of pure SU(6) in so far as decays are concerned. Evidence is presented for a possible octet of 0^+ (scalar) and a nonet of 1^+ (axial-vector) mesons, which together form a 35-plet SU(6) supermultiplet. Pure SU(6) symmetry is applied to the decays, and satisfactory agreement with experiment is obtained. Author

N66-35423# Tata Inst. of Fundamental Research, Bombay (India).
LOW ENERGY π-N SCATTERING WITH NUCLEON ON A REGGE-TRAJECTORY
U. Trivedi *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 529–534 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

An equation formulated by Khuri and Udgaonkar, for low energy pion–nucleon scattering, which treats the nucleon as lying on a Regge-trajectory, is presented. Parametric changes in the equation are incorporated which explicitly exhibit the force-cuts arising from higher mass exchanges, each with a different weightage. The results agree with values obtained by Chew. Thus the present form of the Khuri and Udagaonkar equation appears to be more accurate than the original form. It also shows more easily that it is possible to give a Regge-pole description of the (1/2,1/2) phase-shift consistent with the physical picture of the nucleon given by Chew. The hypothesis of the nucleon as lying on a Regge-trajectory is not in conflict with experimental data. The trajectory is dominant in the low energy region; and pion exchange is responsible for the turning of the phase-shift. L.S.

N66-35424# Tata Inst. of Fundamental Research, Bombay (India).
p-p AND n-p SCATTERING BASED ON TRANSVERSE MOMENTUM DISTRIBUTION AND MANDELSTAM REPRESENTATION
L. K. Chavda and D. S. Narayan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 535–545 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A representation for scattering amplitude is derived which has the Mandelstam singularity structure and which leads to the empirically transverse momentum dependence for both small and large values of p_t (angular distribution in elastic scattering). This representation is generalized to obtain the full scattering amplitude for p–p scattering involving both spin–flip and nonspin–flip parts of the amplitude, as well as for n–p direct and charge exchange scattering. Agreement with experiment and absolute numbers for the model presented indicates the same pattern of interaction and the same forces responsible for p–p scattering and n–p direct and charge scatterings. M.W.R.

N66-35425# Saha Inst. of Nuclear Physics, Calcutta (India).
PARTICLE MIXING IN POSSIBLE AXIAL VECTOR MULTIPLETS
S. Baba Pundari and B. Dutta-Roy *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 548–547 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The recent observation of a $k\pi\pi$ resonance, C(1270), with I=3/2 and $J^P=1^+$ suggests the existence of an axial vector icoso-plet. Since there is already some evidence for axial octets, the effects of mixing among an icoso-plet and two octets, one normal (C=−1) and the other abnormal (C=+1), is considered. Mass formulas are derived.
Author

N66-35426# Tata Inst. of Fundamental Research, Bombay (India).
REGGE-POLE EXCHANGE ANALYSIS OF SOME HIGH ENERGY INELASTIC PROCESSES
D. P. Roy *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 548–556 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Charge exchange K^- −p scattering and the production processes are studied by a Regge-pole exchange mechanism. With the constraints of various quantum numbers in t-channel it is seen that, among the known particle trajectories, only δ-exchange can contribute to these reactions. Then the respective amplitudes are obtained in terms of the δ-trajectory $\alpha(t)$ and the residues. The values of the trajectory parameter $\alpha(t)$ are taken from charge exchange π^-−p scattering data, and the t-dependence of the residues are neglected. These dependences are obtained in terms of the field theoretic coupling constants using the fact that the Regge-pole exchange is identical to the corresponding elementary particle exchange at the pole point. Thus, the production cross-sections contain no arbitrary parameters. The magnitude, energy, and momentum-transfer dependence of these cross sections are found to be in general agreement with experimental data. Author

N66-35427# Indian Inst. of Tech., Kanpur.
DEUTERON PRODUCTION IN PROTON–PROTON COLLISIONS
P. K. Patnaik and B. Deo *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 557–561 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The one nucleon exchange mechanism for the proton–proton reaction $(p+p=d+\pi^+)$ is studied. In the BeV region, the exchange neutron is far off its mass shell, so the n–d–p vertex function is formulated with much care. The calculated cross sections show some of the desired experimental features, but do not agree completely with them.
Author

N66-35428# Indian Inst. of Tech., Kanpur.
ISOSPIN 1/2 AMPLITUDES IN THE πN INTERACTION
Burton J. Moyer *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 562–569 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Elastic and charge exchange scattering of pions by protons allows determination of the pure T = 1/2 scattering. This has been studied over the energy region, including the first three pion–nucleon resonances. The region near the cross-section maximum at 1510 Mev (total c.m. energy) possesses strong P_{11} and D_{13} amplitudes, and an S_{11} amplitude behavior apparently related to the threshold for π^0 production. All of these are of pronounced inelastic character. The 1690 Mev resonance involves superposition of F_{15} and D_{15} amplitudes as its dominant character. The charge exchange experiments also yield the cross sections and angular distributions for π^0 production. The relation of this to pion amplitudes is discussed. A possible cause of P_{11} amplitude strength is seen in the T = 0, J = 0, $\pi-\pi$ interaction. Author

N66-35429# Wisconsin Univ., Madison.
ASSOCIATED PRODUCTION NEAR THRESHOLD
T. O. Binford, M. L. Good, V. G. Lind, and D. Stern *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 570–576 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Cross sections, angular distributions, and polarizations have been measured for the reactions (1) $\pi^-+p\rightarrow\Sigma^0+K^0$ and (2) $\pi^-+p\rightarrow\Lambda^0+K^0$ at incident pion momenta of 1128, 1235, 1277, and 1326 MeV/c. No evidence is found for violation of the triangle inequality from charge independence. Reaction (2) seems to be dominated by the 1690 Mev and 2190 Mev resonances in I=1/2. Author

N66-35430# Osmania Univ., Hyderabad (India). Dept. of Physics.
ANALYSIS OF ANTIPION–N INTERACTIONS IN PHOTOGRAPHIC EMULSIONS
Y. V. Rao, B. K. Rukmini, and A. A. Kamal *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 577–583 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

An analysis is made of 254 interactions caused by a beam of 17.2 GeV/C $\bar{\pi}$, and interactions corresponding to $\bar{\pi}$–N collisions have been separated. Measurements were made with confidence in all the emulsion pellicles up to 10 GeV/C and in a few pellicles up to 15 GeV/C; and there was negligible variation of ionization throughout the pellicles. A tabulation is presented for four three-prong events which appeared to represent tridents; and the sum of pion energies is found to be equal to the beam energy. Longitudinal momentum of the nucleus and effective mass for the three-pion system is also calculated. Pions and protons were identified in more than 90% of the total number of cases analyzed. M.W.R.

N66-35431# Punjab Univ., Chandigarh (India). Dept. of Physics.
ON THE INTERACTION OF 17.2 GeV π^- WITH LIGHT AND HEAVY EMULSION NUCLEI

J. M. Kohli, I. S. Mittra, and M. B. Singh *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 584–590 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $.25

Results of 631 interactions were tracked, and these events have been separated into π^- —AgBr and π^-— CNO groups on the assumption that the overall numbers of events belonging to AgBr and CNO nuclei are governed by the geometrical cross sections. The results regarding mean multiplicity and angular distribution support the internuclear cascade model. M.W.R.

N66-35432# Punjab Univ., Chandigarh (India). Dept. of Physics.

COHERENT PRODUCTION OF PIONS ON EMULSION NUCLEI BY 17.2 GeV PIONS

D. P. Dubey, J. M. Kohli, and M. B. Singh *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 591–597 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Long-range coherent events due to Coulomb and diffraction dissociation of pions were studied which satisfy a number of parameters connecting angle and energy characteristics. The mean free path of these events is 65.1 meters. It has been found that coherent events due to diffraction dissociation take place on lighter semi-transparent nuclei, whereas those due to Coulomb dissociation take place on heavier nuclei. Author

N66-35433# Punjab Univ., Chandigarh (India). Dept. of Physics.

ISOBAR MODEL ANALYSIS OF 8 AND 17 GeV PION NUCLEON INTERACTION IN EMULSION NUCLEI

D. P. Dubey, J. M. Kohli, U. S. Kushwaha, M. B. Singh, and M. S. Swami *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 598–604 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Interactions of eight and 17 Gev pions with nucleons of emulsion nuclei have been analyzed on the basis of an isobar model. Experimental energy distribution of pions and nucleons have been compared with the predictions of the model. Author

N66-35434# Punjab Univ., Chandigarh (India). Dept. of Physics.

ANALYSIS OF 4.4 GeV/c PION AND 6.2 GeV/c PROTON INTERACTIONS IN EMULSION NUCLEI ON ISOBAR MODEL

D. P. Dubey, U. S. Kushwaha, M. B. Singh, and M. S. Swami *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 605–610 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Some features of interactions of 4.4 Gev/c pions and 6.2 Gev/c protons with nucleons of emulsion nuclei have been analyzed in light of the isobar model. Author

N66-35435# Osmania Univ., Hyderabad (India). Dept. of Physics.

ANALYSIS OF SMALL SIZE STARS ($N_h \leq 4$) IN PHOTOGRAPHIC EMULSIONS EXPOSED TO BEAMS OF 24 AND 27 GeV/c PROTONS

G. K. Rao, P. D. K. Rao, and A. A. Kamal *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 611–618 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Small size stars are observed from along the track scanning of 1386 events from various photographic emulsion pellicles. Target mass distribution for stars with $N_s > 2$, frequency of secondary collisions, and energy estimates are discussed. It is noted that most of the events which are due to secondary collision usually have shower tracks in the backward direction, and are associated with large shower multiplicities. For small N_s stars, emission of shower particles is highly asymmetrical and positive, the asymmetry being attributed to persistent protons. Proportion of protons is larger in shower particles of small stars than those of large stars. M.W.R.

N66-35436# Delhi Univ. (India). Dept. of Physics and Astrophysics.

SOME FEATURES OF PROTON–NUCLEON INTERACTIONS AT 23 GeV

B. Bhowmik and R. K. Shivpuri *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 619–628 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Some features of 22.8 GeV proton interactions with nucleons in emulsion have been investigated. From a total of 738 interactions obtained by following 276 meters of proton track length, 94 events were classified as proton–nucleon interactions. Monte-Carlo calculations have been done for the centre of mass momentum distributions of final state protons and pions assuming them to be the decay products of excited baryon states. A two-body decay and isotropic distribution of the emitted particles has been assumed for the decaying isobars. It is observed that the predictions of statistical theory and isobar model calculations for the centre of mass momentum distribution of pions are not different, whereas for nucleons they are widely separated. The experimental centre of mass momentum distribution for protons beyond 1.6 GeV/c can be accounted from isobar model calculations. Author

N66-35437# Indian Inst. of Tech., New Delhi. Dept. of Physics.

ON NEUTRAL BARYONS FROM 24 GeV PROTON INTERACTIONS IN CARBON

K. B. Bhalla, S. K. Jha, P. K. Aditya, and S. Lokanathan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 629–631 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Stars due to neutral baryons produced by 24 GeV proton interaction with carbon nuclei have been analyzed to estimate the energy of the neutral baryons and to study the variation of energy with multiplicity of these stars. Also the average number of neutral baryons within an energy range of 4–6 GeV, produced per 24 GeV proton carbon interaction has been estimated. Author

N66-35438# Indian Inst. of Tech., New Delhi.

ON THE ENERGY OF CHARGED BARYONS FROM 27 GeV PROTON INTERACTIONS IN EMULSIONS

P. K. Aditya *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 632–637 (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Singly charged relativistic particles coming out of 27 GeV proton interactions and emerging in precisely the same direction as the primary have been followed up to the point of interaction. For some the energy has been determined by the multiple scattering. It is found that on the average the surviving baryon retains about one third of the primary energy. Author

N66-35439# Osmania Univ., Hyderabad (India).
PRODUCTION OF DEUTERONS AND TRITONS IN HIGH ENERGY PROTON AND PION INTERACTIONS WITH EMULSION NUCLEI
A. A. Kamal, G. K. Rao, L. S. Rao, Y. V. Rao, and B. K. Rukmini *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 638–646 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Medium energy deuteron yield is investigated in 23 and 24 GeV/C proton and 17 GeV/C pion interactions with emulsion nuclei. In a 24 GeV/C proton collision, the energy carried away by deuterons in the barycentric system when a single pion is produced is found to be 1.82 GeV; and the maximum kinetic energy corresponds to that of the pions in the opposite direction. Extreme backward emission in the barycentric system is attributed to the fact that only relatively slow deuterons are observed; and four events were considered to satisfy the criteria for kinematical consistency with the production of deuterons in the elementary collision of beam proton. In direct π-N interactions, deuterons can be produced only in assocation with an antinucleon of very small cross section. In order to explain the origin of the rest of the deuterons in P interactions and all of the deuterons in π interactions, cascade nucleons must be used. In the energy interval considered, the observed yield of deuterons in P and π interactions can be accounted for to a large extent by the pickup process. M.W.R.

N66-35440# Osmania Univ., Hyderabad (India).
A STUDY OF ELECTRON PAIRS IN PHOTOGRAPHIC EMULSIONS
A. A. Kamal and S. V. Padmavati *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 647–656 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

From an analysis of 178 electron pairs produced in photographic emulsions, exposed to 17 GeV/C $\bar{\pi}$ beam, the distributions of the parameters involving pair energy, opening angle and partition energy have been obtained and a good agreement is found with Olsen's theory. The opening angle method for the energy determination of γ rays has been re-examined in the presence of multiple coulomb scattering and its scope has been compared with theory. Author

N66-35441# Punjab Univ., Chandigarh (India). Dept. of Physics.
STUDY OF SCATTERING FACTOR IN NUCLEAR EMULSIONS
P. M. Sood and S. D. M. Ahuja *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 657–663 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Variation of scattering factor K has been calculated for standard G-5 nuclear emulsions from a few theories pertaining to multiple coulomb scatterings. It has also been estimated experimentally by Y-displacement method for cell lengths 4 cm, 6 cm, and 8 cm, and by coordinate method for cell lengths 4 mm to 4 cm. Results by both the methods agree very well with each other but are lower than the theoretical expectations by about 15 to 25%. Author

N66-35442# Punjab Univ., Chandigarh (India). Dept. of Physics.
IONIZATION LOSS OF ELECTRONS AT HIGH ENERGIES
U. S. Kushwaha *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 664–669 refs Sponsored by Govt. of India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The behavior of ionization loss of electrons in the energy region $\gamma \simeq 100$–5000 has been investigated using Ilford G-5 emulsions. The results are consistent with the existence of a flat plateau in accordance with the Sternheimer's ionization loss theory, though the possibility of a slight increase in ionization loss around $\gamma \simeq 200$ is not ruled out. Author

N66-35443# Tata Inst. of Fundamental Research, Bombay (India).
MECHANISM FOR PRODUCTION OF HFs
D. P. Burte, K. N. Chaudhari, S. N. Ganguli, N. K. Rao, and M. S. Swami *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 690–699 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Hyperfragments produced in interactions of high energy pions (3.5 Gev/c and 17.2 GeV/c) and protons (23 GeV/c) with emulsion nuclei have been investigated and the mechanism for production of hf has been studied. From these studies it is concluded that (a) long range hf (≥ 20 μm) which are due to fragments with mass number ≤ 15, are produced in the evaporation stage of the disintegrations of Ag and Br nuclei of the emulsion, and (b) the short range hf ($\leq 10_{\mu}$m), which have broad mass spectrum with mass numbers between 20 and 90, are partly due to residues of the target nuclei and partly due to fission type of processes that occur in high energy interactions. A qualitative discussion of the sticking probability of Λ° to fragments is given. Author

N66-35444# Delhi Univ. (India). Dept. of Physics and Astrophysics.
MASS ESTIMATES OF SHORT RANGE HYPERFRAGMENTS DECAYING NON-MESONICALLY
B. Bhowmik, T. Chand, and D. V. Chopra *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 700–708 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Masses short range non mesonic hyperfragments, selected on the basis of high visible energy and large momentum unbalance at the secondary star, have been estimated from decay star analysis. The hyperfragments are found to be in the mass range $20 \leq A \leq 90$. The masses have also been estimated from the production star analysis assuming the validity of the the spallation model for the production of such hyperfragments. It is seen that the masses found by both the methods are consistent, thereby justifying the mass determination of short range hyperfragments from production star analysis. Author

N66-35445# Delhi Univ. (India). Dept. of Physics and Astrophysics.
AN ESTIMATION OF Λ-NUCLEAR POTENTIAL WELL DEPTH
B. Bhowmik, T. Chand, and D. V. Chopra *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 709–719 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

An estimate of Λ-nuclear potential well depth (D_{Λ}), from all available experimental results on the Λ-binding energies in heavy hyperfragments ($40 \leq A \leq 100$), has been made. It is suggested that events having $B_{\Lambda} \geq 26.5$ MeV involve neutron emission in their decay. The variation in B_{Λ} for hyperfragment mass

60 to 100 is found to be ≃3.5 MeV. From the B_Λ's of π-p-τ events plotted on a $B_\Lambda - A^{-2/3}$ graph and using exact solution of Schrödinger equation, the value obtained for D_Λ is 37 MeV.
Author

N66-35446# Tata Inst. of Fundamental Research, Bombay (India).
ANALYSIS OF NON-MESONIC HFs
K. N. Chaudhari, S. N. Ganguli, N. K. Rao, and M. S. Swami *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 720–729 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Nonmesonic hyperfragments, of range R>20 μm, produced in interactions of high energy pions (5.5 GeV/c and 17.2 GeV/c) and protons (23.0 GeV/c) with emulsion nuclei have been investigated. The charge spectrum of the HFs and the fast proton spectrum (E≥30 MeV) as a function of the charge of the HF has been obtained. Also the charge spectrum of 68 MHFs (R>20 μm) has been obtained. The non-mesonic/mesonic ratio and the Λn/ΛP stimulation ratio as a function of charge of the HF is given.
Author

N66-35447# Tata Inst. of Fundamental Research, Bombay (India).
STUDY OF MESIC HYPER FRAGMENTS
K. N. Chaudhari, S. N. Ganguli, N. K. Rao, and M. S. Swami *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 730–733 ref (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Binding energies of 141 mesic hyperfragments from K^- interactions at rest in nuclear emulsion are reported. A stack of 150-K5 emulsions was exposed to 350 MeV/c K^- beam. Stars produced by stopping K^- mesons were noted; and the density of the stack was determined by measuring the range of protons arising from Σ^+ decays at rest. The events were analyzed by computer, and each event was considered uniquely identified if there existed only one decay scheme with binding energy consistent with its established value, and unbalanced momentum was zero within experimental error. The events were classified into three groups: (a) two body decays, (b) three body decays, and (c) other, including those in which a neutron or an invisible recoil was involved. A table is given for various decay schemes and their binding energies. E.A.O.

N66-35448# Tata Inst. of Fundamental Research, Bombay (India).
STUDY OF MULTINUCLEON INTERACTIONS OF Λ° IN HYPERFRAGMENTS
D. P. Burte, K. N. Chaudhari, S. N. Ganguli, N. K. Rao, and M. S. Swami *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 734–738 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Analysis of nonmesonic hyperfragments ($NMHF_e$), produced by 3.5 GeV/c π^-, 17.2 GeV/c π^- and 23 GeV/c protons in nuclear emulsions have been made, and from this sample, those having two fast particles (range ≥2mm) at the decay vertices of $MNHF_e$ were selected to study the stimulated decay of Λ° by two or more nucleons in $NMHF_e$. From this study it is concluded that the contribution of Λ°–multinucleon interaction to decay of $NMHF_e$ is small and there is a strong evidence for the existence of final state interactions in these decays.
Author

N66-35449# Tata Inst. of Fundamental Research, Bombay (India).
KINEMATICAL CALCULATION OF Λ-NUCLEON STIMULATION REACTION FOR HYPERFRAGMENTS OF MASS A=50
S. N. Ganguli and M. S. Swami *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 739–744 (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Energy spectra of fast protons (E≥30 MeV) have been calculated for hyperfragments of mass A=50, from Λ-proton and Λ-neutron stimulation process respectively. It has been concluded by comparing with experimental energy spectrum, that Λn/Λp stimulation ratio is ~ 5. It has been estimated, from this ratio, that the emission frequencies of two fast protons, from Λ-single nucleon stimulation, both with E≥20 MeV and with E≥30 MeV are ≃3.3% and ≃1.7% respectively.
Author

N66-35483# Michigan Univ., Ann Arbor. Dept. of Physics.
THE POLARIZATION PARAMETER IN ELASTIC PROTON–PROTON SCATTERING FROM .75 TO 2.84 GeV Technical Report No. 23
Homer A. Neal, Jr. Apr. 1966 114 p refs
(Contract Nonr-1224(231))
(Rept.-03106-23-T; AD-635017) CFSTI: HC $4.00/MF $0.75

A double-scattering technique was employed to measure the polarization parameter in elastic proton–proton scattering at .75, 1.03, 1.32, 1.63, 2.24, and 2.84 GeV. An external proton beam from the Brookhaven Cosmotron was focussed on a three inch long liquid hydrogen target and the elastic recoil and scattered protons were detected in coincidence by scintillation counters. The polarization produced in the scattering process was inferred from the azimuthal asymmetry exhibited in the scattering of the recoil beam from a carbon target. This asymmetry was measured by a set of two scintillation counter telescopes which symmetrically viewed the carbon target. The analyzing power of this arrangement was previously determined in an independent experiment employing a 40% polarized proton beam. The corrected values of the polarization parameter are exhibited as a function of the center-of-mass scattering angle for each incident beam energy. The prediction of the Regge theory that the polarization parameter in elastic proton–proton scattering is related to the total proton–proton and proton–antiproton cross sections was found to be consistent with the experimental results.
Author (TAB)

N66-35635# Maryland Univ., College Park. Dept. of Physics and Astronomy.
THE USE OF UNITARITY IN PROVING DOMERANCHUK'S THEOREM ON CROSS SECTIONS AT HIGH ENERGIES
R. J. Eden Nov. 1965 8 p refs
(Grant AF-AFOSR-500-64)
(TR-525; AD-634705) CFSTI: HC $1.00/MF $0.50

Pomeranchuk's theorem states that the total cross sections for particle–particle and for particle–antiparticle scattering become equal in the limit of high energy. Two assumptions in the proof of this theorem are made. The first assumption limits the rate of change of the difference between particle and antiparticle cross sections; the second limits the rate of change of the modulus of the difference between the corresponding amplitudes. The role of these two assumptions in the proof of Pomeranchuk's theorem are assessed. H.S.W.

N66-35667# European Organization for Nuclear Research, Geneva (Switzerland).
CREATION OF PARTICLES AT COSMIC-RAY ENERGIES

B. Peters (Niels Bohr Inst.) 24 Jun. 1966 30 p refs Presented at the Sem. for an Intersecting Storage Rings Study Group, Geneva, 10 Mar. 1966
(CERN-66-22)

The general features of nuclear collisions at very high energy are reviewed, and used to predict secondary particle spectra for future accelerators. The experimental techniques applicable in various energy regions are described. The main experimental evidence for invariants, or features of particle creation, is discussed. High energy collisions are analyzed, taking into account the fact that some of the created particles are decay products of colliding nucleons. The observations, and their interpretation according to a phenomenological model, are summarized. N.E.N.

N66-35693# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
SUM RULES AND JOST-LEHMANN-DYSON REPRESENTATION
J. L. Gervais and M. Le Bellac Jul. 1966 29 p refs
(TH/165) CFSTI: HC $2.00/MF $0.50

The representation is applied to study the matrix elements of current commutators between spinless one-particle states. The sum rule of Fubini is derived from assumptions on the behavior at infinity of certain spectral functions while difficulties are shown to arise for the sum rules already obtained from time derivative in the Breit system. The equal time limits of the matrix elements are studied and sufficient conditions are given so that the commutators involving, at least, one time component take the form of the quark model. This is shown to be impossible for the commutator of space components. It is pointed out that the hypotheses leading to the equal time limit are much stronger than the ones which are sufficient to get Fubini's sum rule. Author

N66-35697# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Chemie.
MOLECULAR PLATING V: THE INFLUENCE OF SOME EXPERIMENTAL FACTORS ON THE DEPOSITION YIELD
N. Getoff, H. Bildstein, E. Proksch, and H. Saukel May 1966 19 p refs Submitted for Publication
(SGAE-CH-34/1966) CFSTI: HC $1.00/MF $0.50

The effects of cathode diameter, electrode distance, initial current and temperature on the deposition yield using the molecular plating method were studied. Sr^{90}/Y^{90} was used as a model nuclide. The best conditions for obtaining a uniform layer with 100% yield are reported. Author

N66-35705# European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Div.
DETERMINATION OF PARTICLE MOMENTA IN SPARK CHAMBER AND COUNTER EXPERIMENTS
L. Griffiths, C. R. Symons, and B. Zacharov 21 Apr. 1966 51 p refs
(CERN-66-17)

A general trajectory fitting model is described for the passage of a charged particle from passing through a magnetic field for the determination of its momentum in spark chamber experiments. The derivation of the field is presented for one-, two-, and three-dimensional field models, and for a three-dimensional experimentally measured field mesh. The accuracy of the procedure, the computer storage requirements, and information retrieval times are also discussed. It was concluded that the iterative, least squares method can be successfully used with a wide variety of experimental data. The one- and two-dimensional field models have systematic errors of less than one or two percent only if the trajectory of the particle through the magnetic field is confined to a region where the model is known to be accurate. The three-dimensional model can be used for an inhomogeneous magnetic field. It was further concluded that if a high accuracy of momentum is required, it is first essential to represent the magnetic field accurately before concentrating on determining spark coordinates to a very high accuracy. N.E.N.

N66-35718# Brookhaven National Lab., Upton, N. Y.
NEUTRON THERMALIZATION AND DIFFUSION IN NON-ISOTHERMAL MEDIA
Bal Raj Sehgal Oct. 1965 14 p refs
(Contract AT(30-2)-GEN-16)
(BNL-947; T-393)) CFSTI: HC $1.00/MF $0.50

The effect of nonuniform temperature distribution on the stationary thermal neutron distribution is studied in an extended nonabsorbing, nonisothermal moderator medium. Expressions are derived for the neutron concentration diffusion coefficient and the neutron "thermal" diffusion factor which are valid for a general scattering law. Specific results are obtained for a hydrogen gas moderator and for a heavy gas moderator. The results for neutron distribution, the diffusion coefficient and the thermal diffusion factor are compared with those of previous studies. Author (NSA)

N66-35719# Los Alamos Scientific Lab., N. Mex.
PROMPT AIR FLUORESCENCE EXCITED BY HIGH ALTITUDE NUCLEAR EXPLOSIONS
E. W. Bennett and R. F. Holland 4 May 1966 76 p refs
(Contract W-7405-ENG-36)
(LA-3409-MS, Suppl.) CFSTI: HC $3.00/MF $0.75

Details of the design, calibration, and use of the photo-electric "log box" detectors used to obtain air fluorescence data are given. Descriptions of the High Altitude Fluorescence (HAF) and High Altitude Resonance Absorption Calculation (HARAC) machine codes are presented. These descriptions are concerned mainly with assumptions, derivations, and some program features of the codes; no coding details are provided. The procedures used to obtain absorption cross sections for use in HARAC are described, including a discussion of the assumptions and the approximation used to account for the rotational structure. The importance of some neglected processes is discussed. NSA

N66-35721# Oak Ridge National Lab., Tenn.
EFFECT OF ERROR ON RESULTS OF A LOW-ENERGY INTRANUCLEAR CASCADE CALCULATION
Hugo W. Bertini Jun. 1966 188 p refs
(Contract W-7405-ENG-26)
(ORNL-3786) CFSTI: HC $5.00/MF $1.00

The program used in the intranuclear calculations issued as ORNL-3383 was found to contain an error. Correcting the error results in a better agreement with experiment for the energy dependence of the (p,pn) cross sections previously calculated and in most cases in a better agreement in absolute value as well; however, a disagreement with experiment was found in the shape of the neutron spectrum for the case of 50-MeV protons on lead at 0°. All of the distributed data which were generated using the program that contained the error were replaced by data generated using the corrected program. Author (NSA)

N66-35732*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
THE CUSP CONDITIONS FOR MOLECULAR WAVE FUNCTIONS

Russell T. Pack and Joseph O. Hirschfelder 5 Nov. 1965 25 p refs
(Grant NsG-275-62)
(NASA-CR-68758; WIS-TCI-123) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Cusp conditions are derived that describe the behavior of the wave function at the singularities of the Coulomb potential corresponding to the coalescence of two or more particles. In this derivation, the wave function is not spherically averaged; the fixed-nuclei approximation is not required; and the wave function may have nodes at the singular points. In addition to the general treatment, the cusp conditions for diatomic molecules are discussed in three different coordinate systems. Author

N66-35740# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
^{232}Th AND ^{238}U FISSION INDUCED BY LOW ENERGY MONOCHROMATIC γ-RAYS
A. Manfredini, M. Muchnik, M. Severi, H. Bosch, J. Lang et al 1963 19 p refs *Its* Notas de Fisica, V. XI, No. 5 Submitted for Publication
CFSTI: HC $1.00/MF $0.50

The photofission cross-sections of ^{232}Th and ^{238}U have been measured with nuclear emulsions at 6.61 MeV. Very good statistics were obtained combining a new type of monochromatic γ-rays source with some new developments in the technique for leading and processing nuclear emulsions. Author

N66-35743*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
CONSTRAINED VARIATION METHOD IN MOLECULAR QUANTUM MECHANICS. COMPARISON OF DIFFERENT APPROACHES
D. P. Chong and Yecheskel Rasiel 26 Aug. 1965 21 p refs (Grant NsG-275-62)
(NASA-CR-68757; WIS-TCI-119) CFSTI: HC $1.00/MF $0.50 CSCL 20J

Numerical results are presented for the lithium hydride molecule, obtained by different techniques of the constrained variation method. The constrained wave function, the degree to which the constraint is satisfied, and the sacrifice in energy are compared. The constraint operator used was the electronic dipole moment in one case and the total Hellman–Feynman force in another. In both cases, the parametrization procedure in the direct solution approach was found to be superior. Author

N66-35796*# Harvard Coll. Observatory, Cambridge, Mass. Shock Tube Spectroscopy Lab.
THE THEORY OF DISPERSION PROFILES IN ATTENUATION
Scientific Report No. 13
Bruce W. Shore Jul. 1966 120 p refs
(Grant NsG-438)
(NASA-CR-77665) CFSTI: HC $4.00/MF $1.00 CSCL 20H

This paper examines attenuation processes from the viewpoint of collision theory, using the optical theorem to connect attenuation cross-section σ and refractivity n with diagonal elements of the T matrix. This approach provides resonance profiles (for "natural" lines shapes) of the form

$$\sigma(\omega) = C + \frac{(\Gamma/2)\,B + (\omega-\omega_0)\,A}{(\omega-\omega_0)^2 + (\Gamma/2)^2}$$

$$n(\omega) - 1 = \frac{Nc}{2\omega}\left[\frac{(\Gamma/2)\,A - (\omega-\omega_0)\,B}{(\omega-\omega_0)^2 + (\Gamma/2)^2}\right]$$

where the profile parameters A, B, C, D, Γ, ω_0 are given in terms of atomic matrix elements. Part I reviews the notion of resonances. Part II summarizes the relevant results of collision theory, stressing physical interpretation, and gives a definition for excited (or resonance) states based on a simple partition of basis states into two classes. Part III applies perturbation theory to the calculation of resonance profiles. Part IV applies these results specifically to the attenuation and refraction of photons by tenuous gases, with particular attention paid to the profiles of autoionizing lines. Author

N66-35812# Los Alamos Scientific Lab., N. Mex.
REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP
H. T. Motz, comp. [1966] 233 p refs Meeting held at Washington, D. C., 24–25 Mar. 1966
(WASH-1068) CFSTI: HC $6.00/MF $1.25

Included are brief summaries of reports which were presented to the AEC Nuclear Cross Sections Advisory Group at the meeting on March 24–25, 1966, in Washington, D. C. These reports contain an informal statement of recent development, changes of emphasis, and preliminary data which are of importance to the cross section measurement program of the AEC. NSA

N66-35821# Oak Ridge National Lab., Tenn.
ELECTRONUCLEAR DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING DECEMBER 31, 1965
May 1966 124 p refs
(Contract W-7405-ENG-26)
(ORNL-3940) CFSTI: HC $4.00/MF $0.75

Separate abstracts were prepared for the 4 included chapters. NSA

N66-35828# Polish Academy of Sciences, Cracow.
COMPUTATION $\delta(\theta)$ ACCORDING TO THE STRONG ABSORPTION THEORY GIVEN BY FRAHN AND VENTER. PROGRAMS FOR COMPUTER UMC-1 [OBLICZANIE $\delta(\theta)$ WEDLUG TEORII SILNEJ ABSORPCJI FRAHNA-VENTERA PROGRAMY DLA MASZYNY CYFROWEJ UMC-1]
Alicja Dudek Jan. 1966 71 p refs In POLISH; ENGLISH summary
(INP-448/PL)

The programs for computation of the differential cross sections for elastic scattering of charged particles in the presence of strong absorption are presented according to the theory given by Frahn and Venter both with and without consideration of the volume absorption. Author (NSA)

N66-35828# Brookhaven National Lab., Upton, N. Y.
THE NON-STEADY PROBLEMS OF QUANTUM MECHANICS AND THE LAPLACE TRANSFORM
Yu. N. Demkov [1966] 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 166, 1966 p 1067–1079
CFSTI: HC $1.00/MF $0.50

There are not many cases known where the Shroedinger non-steady state equation $H(t)\psi=[H_0+V(t)]\psi=i\partial\psi/\partial t$ with an energy operator, H, dependent on time can be solved accurately or brought to a solution of a steady state problem with operator, H_0, independent of time. It is shown that for a special, although a fairly wide class of operators V(t) of the type $V=|\phi\rangle\beta_k\langle\phi|$ the problem may be solved accurately as a contour integral using Dirac's notations). Thus, operator, V, must linearly depend on time and be a projection operator on a certain basis vector $|\phi\rangle$ in the space functions $|\psi\rangle$. It is shown that the properties of the energy operator, H (in particular, the behavior of its eigenvalues with respect to

time), are such in this case that in various specific problems, for example, in the collision theory, an operator of this type may be approximately substituted for the real energy operator. NSA

N66-35829# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON RELATIVISTIC WAVE PACKETS IN SPACE AND TIME, PART I [O RELYATIVISTSKIKH VOLNOVYKH PAKETAKH V PROSTRANSTVE I VREMENI, I]

I. V. Polubarinov 1966 26 p refs In RUSSIAN
(JINR-P-2691)

A special representation (picture of measurement) is introduced so that time in quantum mechanics should have equal rights with other space coordinates. The covariant form is obtained for the uncertainty relations for time—coordinate and energy—momentum. Minimizing packets are constructed in space and time. The dynamical properties of such packets are briefly considered. Author (NSA)

N66-35830# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

QUANTUM THEORY OF GRAVITY IN THE EISENBERG REPRESENTATION AND INTERACTION REPRESENTATION [KVANTOVAYA TEORIYA TYAGOTENIYA V GAIZENBERGOVSKOM PREDSTAVLENII I V PREDSTAVLENII VZAIMODEISTVIYA]

V. I. Ogievetskii and I. V. Polubarinov 12 Apr. 1966 30 p refs In RUSSIAN
(JINR-P-2692)

The quantum theory of gravity is considered from the point of view of field theory. The Heisenberg representations and interaction representation are given. A general simple recipe for constructing the states, which satisfy the supplementary condition, is formulated in the interaction representation. The S-matrix structure is analyzed. Author (NSA)

N66-35832# Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics.

ATOMIC MOTIONS IN MONATOMIC FLUIDS

Rashmikant Chimanlal Desai (Ph.D. Thesis) Jun. 1966 85 p refs
(Contract AT(30-1)-3326)
(NYO-3326-13) CFSTI: HC $3.00/MF $0.75

Van Hove's self correlation function, $G_s(r, t)$, for monatomic gases is studied within the kinetic approach initiated by Nelkin. Non-Gaussian corrections are calculated for three types of interatomic potentials: rigid sphere potential, Lenard Jones potential and exponential 6 potential. It is found that the behavior of non-Gaussian corrections for all three potentials is qualitatively similar to that found for the single relaxation time kinetic model by Nelkin and Ghatak and to that found by Rahman from a high density molecular dynamics calculation. It is also found that the corrections are larger for higher densities and at low densities, the corrections increase almost by a factor of two when attractive forces are included. Fourier transforms of $G_s(rt)$ are also studied. The intermediate scattering function, $X_s(k,t)$ and the scattering law, $S_s(d,\omega)$ are calculated for real monatomic gases. Using the spatial moments for liquid argon, as calculated by Rahman from molecular dynamics and using his delayed convolution approximation, the energy distribution of scattered neutrons and $S(\kappa,\omega)$ for liquid argon are calculated. Results are compared with the experiments of Chen et al., and it is shown that the recent neutron scattering experiments and the computer experiments are in semiquantitative agreement. Theoretical questions resulting from this conclusion are pointed out. Author (NSA)

N66-35833# Joins Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

REPRESENTATIONS 189 AND 405 OF THE GROUP SU(6) AND CLASSIFICATION OF MESONIC RESONANCES 2^+, 1^+, AND 0^+ [PREDSTAVLENIYA 189 I 405 GRUPPY SU(6); KLASSIFIKATSIYA MEZONNYKH REZONNANSOV 2^+, 1^+, AND 0^+]

L. Enkovski, V. V. Kukhtin, and Nguyen Van Hieu 1966 34 p refs In RUSSIAN
(JINR-P-2701)

A possibility of classification of mesonic resonances 2^+, 1^+ and 0^+ in the framework of the group SU(6) is considered. The decomposition of the 189-plet and 405-plet of the group SU(6) into irreducible multiplets of its subgroups $SU(3) \otimes SU(2)$ and $SU(4) \otimes SU(2)$ is investigated, and values of mixing coefficients between different unitary multiplets with the same spin are derived. C-parity of particles in the given multiplet is determined and relations between the decays constants of the type $2^+ \rightarrow 0^- + 0^-$, $0^+ \rightarrow 0^- + 0^-$ and $1^+ \rightarrow 0^- + \gamma$ are derived. Author (NSA)

N66-35834# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

SOME PROBLEMS OF QUANTUM THEORY OF SCALAR FIELD WITH POINT SOURCES [NEKOTORYE VOPROSY KVANTOVOI TEORII SKALYARNOGO POLYA S TOCHECHNYMI ISTOCHNIKAMI]

M. I. Shirokov 18 Apr. 1966 18 p refs In RUSSIAN Submitted for Publication
(JINR-P-2700)

The mathematical and physical vacuum vectors are orthogonal in the model considered. In this case there are grounds not only physical but also mathematical for the introduction of the so-called "clothed" particle operators. It is shown that canonical representations with vacua are possible simultaneously for the "clothed" and "bare" operators. It turns out that the above orthogonality suggests the Fock-Tamm-Dancoff type of equations as a suitable apparatus for the solution of physical problems provided that the corresponding Fock amplitudes are properly defined. Author (NSA)

N66-35838# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON AVERAGE FIELD LEVELS OF NUCLEI [OB UROVNYAKH SREDNEGO POLYA YADER]

B. N. Kalinkin, Ya. Grabovskii, and F. A. Gareev 1966 22 p refs In RUSSIAN Submitted for Publication
(JINR-P-2682)

A variant of an approximate solution of the Schrodinger equation with the Saxon–Wood potential is considered. Wave functions of one-particle analytical states are obtained, as well as some integrals of their combinations. Ther results can be applied to the theory of the nucleus and nuclear reactions. Author (NSA)

N66-35840# California Univ., Livermore. Lawrence Radiation Lab.

NEUTRALIZATION OF FAST HYDROGEN IONS COLLIDING WITH H_2, CO, CH_4, AND H_2O MOLECULES

E. S. Chambers 8 Jun. 1965 17 p refs
(Contract W-7405-ENG-48)
(UCRL-14214) CFSTI: HC $1.00/MF $0.50

Fast neutral particle production cross sections, for H^+, H_2^+, and H_3^+ ions colliding with H_2, CO, CH_4, and H_2O molecules, were obtained by measuring the quantity of fast neutral particles produced. Ion energies ranged from 1 to 5[illegible] kev. Electron capture cross sections for H^+ increased in the order H_2, CO, CH_4, and H_2O. They extended at 10 kev from 8 $Å^2$ for H_2 to 14 $Å^2$ for H_2O. Similarly for H_2^+ the neutral production cross sections at 10 kev ranged from 8 $Å^2$ for

H_2 to 19 $Å^2$ for H_2O. The H_3^+ cross section versus energy curves showed broad maxima. The position of these maxima increased in both intensity and energy with the various gases in the order H_2, CO, CH_4, and H_2O. Gryzinski's criterion for the energy of maximum cross section led to values approximating those observed. Calculations of electron capture as a function of energy, based on Gryzinski's approximation formulas, are compared with the present experimental results. Author (TAB)

N66-35841# Argonne National Lab., Ill.
SOME PRELIMINARY RESULTS OF AN ANALYSIS OF THE ANL-CERN SPARK CHAMBER PICTURES
Y. S. Kim (Ohio State Univ.) [1965] 31 p refs
(Contract W-31-109-ENG-38)
(COO-1261-4) CFSTI: HC $2.00/MF $0.50

In order to study the feasibility of extracting Λ^0 and Σ^0 polarizations from the ANL-CERN pictures, 476 $2V^0$-events were analyzed and 152 ($\pi^- + p \rightarrow K_1^0 + \Lambda^0$) events and 28 ($\pi^- + p \rightarrow K_1^0 + \Sigma^0$) events at the incident beam momentum of 1.17 BeV/c were accepted. From these samples it was found that: $\langle \alpha_\Lambda P_\Lambda \rangle = +0.61 \pm 0.10$ and $\langle \alpha_\Lambda P_{\Sigma^0} \rangle = +0.08 \pm 0.62$. An examination of 96 $2v^0$-events from ^{12}C target indicates that the samples have about 20% ^{12}C (Fermi) contamination. Author (NSA)

N66-35842# Michigan Univ., Ann Arbor.
A MEASUREMENT OF THE 2^3P FINE STRUCTURE OF ^4He
Jacob Robert Lifsitz (Ph.D. Thesis) 1965 173 p refs
(Contract AT(11-1)-1112)
(COO-1112-21) CFSTI: HC $5.00/MF $1.00

An accurate determination was made of the fine structure in the n=2 triplet P-states of ^4He. The method used is an application of level-crossing spectroscopy, in which one detects a change in the angular distribution of resonance fluorescence in a magnetic field when the field value is such that a crossing occurs between a pair of excited state Zeeman sublevels. Four such crossings are studied in detail, at field values (in gauss) of: H_A=562.8, H_B=578.5, H_C=1227.4, H_D=8280.0. The magnetic field at which the altered scattering is observed is measured in terms of the nuclear magnetic resonance frequency of protons (deuterons) in $H_2O(D_2O)$. Using the solutions to the secular equations for the Zeeman effect, in conjunction with certain accurately known ratios of atomic and nuclear g-values, the extrapolation to the zero-field separations, $\epsilon_{12}=E(^3P_1)-E(^3P_2)$ and $\epsilon_{02}=E(^3P_0)-E(^3P_2)$, is effected. NSA

N66-35844# California Univ., Berkeley. Lawrence Radiation Lab.
THE HYPERFINE-STRUCTURE ANOMALIES OF ^{198}Au AND ^{199}Au
Vanden Bout and Paul Adrian 31 Mar. 1966 95 p refs
(Contract W-7405-ENG-48)
(UCRL-16757) CFSTI: HC $3.00/MF $0.75

The hyperfine-structure separations and nuclear magnetic moments of 198Au (2.70d) and 199Au (3.15d) were measured using the atomic-beam magnetic-resonance method. The ratio of the electronic g factor of gold to those of potassium and cesium was measured. Second-order corrections to the hyperfine structure are shown to be negligible. The nuclear results are interpreted in terms of the shell model of the nucleus with allowance for configuration mixing. The measurement of some ratios of alkali electronic g factors was also made. NSA

N66-35845# Rensselaer Polytechnic Inst., Troy, N. Y.
LINEAR ACCELERATOR PROJECT
R. C. Block et al [1966] 144 p refs
(Contract AT(30-3)-328)
(RPI-328-56) CFSTI: HC $4.00/MF $1.00

Separate abstracts were prepared for 4 of the 5 included sections. The remaining section contained only a brief summary of 50-MeV electron radiation damage studies on germanium and silicon. NSA

N66-35846# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
A GALACTIC FIELD OF HYPERCHARGES AND THE K^0_2 DECAY INTO THE PIONS
V. L. Lyuboshits, E. O. Okonov, and M. I. Podgoretsky 1965 11 p refs
(JINR-D-1925)

Using the action by contact principle the main properties of the classical fields produced by the nonconserving charges were analyzed. It was shown that, despite the widely spread opinion, the introduction of such fields does not lead to a violation of the energy conservation law. It was also shown that the existence of the $K^0_2 \rightarrow \pi^+\pi^-$ decay which was recently observed experimentally cannot be quantitatively accounted for the action of the fields under discussion. Author (NSA)

N66-35847# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
OPTIC—A PROGRAM FOR THE CALCULATION OF NUCLEAR CROSS SECTIONS AND LEGENDRE MOMENTS USING THE OPTICAL MODEL
D. T. Goldman, C. R. Lubitz, G. A. Shanholt, and E. L. Slaggie May 1965 46 p refs
(Contract W-31-104-ENG-52)
(KAPL-3085) CFSTI: HC $2.00/MF $0.50

OPTIC is a Fortran digital computer program for the calculation of Legendre moments of the shape-elastic angular distribution, the total cross section, and the shape-elastic angular distribution itself, according to the optical model. A multidimensional search is available for obtaining the best potential well parameters. Fluctuations in nuclear cross sections are accounted for by combining resonance phase shifts with those calculated with the optical model. Author (NSA)

N66-35849# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INTERACTION OF ELEMENTARY PARTICLES WITH ATOMIC NUCLEI IN THE ENERGY REGION 1-30 GeV [VZAIMODEISTVIE ELEMENTARNYKH CHASTITS S ATOMNYMI YADRAMI V OBLASTI ENERGII 1-30 GeV]
I. Z. Artykov, V. S. Barshenkov, and S. M. Eliseev 1965 10 p refs In RUSSIAN Submitted for Publication
(JINR-P-2279)

The results are given of statistical calculations of proton interactions with energies 6.2, 9.17, and 25 Bev with emulsion nuclei. The calculations are made in the framework of cascade-evaporation model. Special emphasis is laid upon the interactions involving a group of heavy nuclei. The results of calculations are in good agreement with experimental data. Author (NSA)

N66-35850# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
THE CURRENT GENERATED ALGEBRAS AND FORM-FACTORS
N. N. Bogolubov, A. A. Makarov, V. Matveev, Nguyen Van Hieu, J. A. Smorodinsky et al 21 Jul. 1965 9 p refs
(JINR-E-2294)

A method for studying the algebra of currents is proposed. Relations are obtained for the form factors that describe the electromagnetic and weak interactions of mesons and quarks. NSA

N66-35851# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

FALLIBILITY OF USING χ^2 CRITERION IN THE PHASE SHIFT ANALYSIS FOR CHOOSING STATISTICALLY PERMISSIBLE AMBIGUOUS SOLUTIONS

A. A. Tyapkin 4 Sep. 1965 10 p refs
(JINR-E-2353)

The incorrectness of using the χ^2-criterion for defining the statistical reliability of ambiguous solutions of the phase-shift analysis is shown. A correct method for comparing the reliabilities of various solutions is given. The comparison of methods shows that in the case of the large number of degrees of freedom of the χ^2-distribution, the over-estimation of the solution reliability corresponding to the relative minima of the functional takes place. Author (NSA)

N66-35852# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

EVIDENCE FOR $K^0\bar{K}^0$ RESONANCE AT 1280 MeV [OBNARUZHENIE REZONANSA V SISTEME $K^0\bar{K}^0$ PRI 1280 MeV]

V. V. Barmin, A. G. Dolgolenko, I. A. Yerofeev, Yu. S. Krestnikov, A. G. Meshkovskii et al 25 Sep. 1964 17 p refs In RUSSIAN; ENGLISH summary Presented at 12th Intern. Conf. on High-Energy Phys., Dubna, USSR, 1964 *Its* Rept.-284
(NP-15377)

Stereo-photographs of 159 pairs of $K^0\bar{K}^0$ were obtained by exposing a 17-liter propane-xenon bubble chamber to a 2.8 Bev/c meson (π^-) beam of the ITEP proton synchrotron. The mesons (K^0) were registered with $K_2^0 \rightarrow \pi^+ + \pi^-$ decay. The distribution of the effective mass $K^0\bar{K}^0$ pairs shows the bump at 1280 Mev with the width ~80 Mev. This result coincides with the data of a paper by Barmin et al. United distribution contains 194 pairs of $K^0\bar{K}^0$. The number of events in the peak is about 35. This peak cannot be explained by the reaction $\pi^- + N \rightarrow \pi^- + N + K^0 + \bar{K}^0 + m\pi$ (m = 0, 1, 2, 3 . . .) or known resonances in the KN and Kπ systems. The hypothesis is discussed that the peak may be explained by f— and A_2^0-mesons productions with following decays $f \rightarrow K_1^0 + K_1^0$ and $A_2^0 \rightarrow K_1^0 + K_1^0$. The high limit was obtained for the ratio $w(f \rightarrow K_1^0 + K_1^0)/w(f \rightarrow \pi^+ + \pi^-) \leq 2.3 \pm 1.0\%$. Author (NSA)

N66-35853# Research Inst. of National Defence, Stockholm (Sweden).

AN ENERGY-WEIGHTED MI SUM RULE

G. Arbman Mar. 1966 25 p refs
(NP-15899; A-4475-411)

An energy-weighted M1 transition sum rule for nuclei is constructed, using shell-model jj-coupled wave functions. The sum is compared to the model-independent energy-weighted E1 sum and is calculated for spherical nuclei in the region $58 \leq A \leq 210$. Author (NSA)

N66-35855# Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.

COINCIDENCE MEASUREMENTS ON NUCLIDES DECAYING BY ELECTRON CAPTURE

J. Steyn and A. S. M. De Jesus Jan. 1966 20 p refs
(FIS-15; NP-15912)

The measurement of disintegration rates and branching ratios of the electron-capturing nuclides ^{22}Na, ^{65}Zn, and ^{74}As by coincidence-counting methods is described. The following branching ratios were determined: ^{22}Na—electron-capture to positron emission, 0.103±0.018; ^{65}Zn—ground state electron-capture to positron emission, 29.6±0.5, intensity of the positron branch, 0.0164±0.0003, and the intensity of electron-capture to the excited state, 0.4980±0.0018. Author (NSA)

N66-35856# Paris Univ., Orsay (France). Faculte des Sciences.

EXPERIMENTS OF THE AdA COLLISIONS RING

Jacques Haissinski (Ph.D. Thesis) [1965] 136 p refs In FRENCH *Its* Ser. A, No. 81
(NP-15656)

The experiments made at Orsay on the AdA collision ring are reported. A description is first given of the AdA, and the injection of electrons and positrons is described. The properties of the orbit and the beam are derived and the number of stored particles is determined. The lifetime of the particles in the collision ring was studied. Investigations on beam–beam interactions are reported. NSA

N66-35858# International Centre for Theoretical Physics, Trieste (Italy).

REGGE POLE BEHAVIOR IN AN SL(2,c) MODEL FIELD THEORY

G. Cocho and Harun Ar-Rashid May 1966 24 p refs Submitted for Publication
(IC-66/46)

A model SL(2,c) field theory proposed by Fronsdal was employed to evaluate a strong interaction vertex. Using this vertex function and an assumed mass spectrum of the exchanged SL(2,c) tower in a Feynman diagram, the high-energy and low momentum transfer part of the amplitude was extracted out. This shows characteristic Regge behavior and compares favorably with the proton–proton scattering data, although the numerical agreement is not considered significant in this model study. Author (NSA)

N66-35859# California Univ., Berkeley. Lawrence Radiation Lab.

ANTIPROTON ANNIHILATION AT REST IN DEUTERIUM

Gabriel Kojoian (Ph.D. Thesis) 21 Feb. 1966 89 p refs
(Contract W-7405-ENG-48)
(UCRL-16717) CFSTI: HC $3.00/MF $0.75

The annihilation of antiprotons at rest in the LRL 15-inch deuterium-filled bubble chamber ($E_{center\ of\ mass}$ = 2.8137 Bev) is reported. The experiment was performed at the Bevatron. A total of 2071 events at rest were observed. The ratio of proton to neutron annihilations is 1.33 ±0.07. The reaction $\bar{p}d \rightarrow e\pi^- + 2\pi^+ + n\pi^0 + p$ was examined extensively. The number of neutral pions was determined and it was found that the deviation between the statistical model and the experimental data was not overwhelming. The measured pion momentum and multiplicity distributions are in agreement with the Lorentz-invariant phase-space model when one considers an interaction volume of $\Omega = \lambda\Omega_0$ where $\Omega_0 = 4/3\,\pi(\hbar/m_\pi c)^3$, $\lambda = 10$, and m_π is the mass of the pion. The momentum distribution of the observed recoil proton showed a marked difference from the internal momentum distribution of the deuteron. Secondary effects were considered because final state pion-proton interactions were not the major contributors to the annihilation dynamics. Stars yielding K mesons accounted for a fraction (0.05 ±0.01) of the total annihilation events observed. Author (NSA)

N66-35860# International Centre for Theoretical Physics, Trieste (Italy).

THE REPRESENTATIONS OF SL(n,C)

C. Fronsdal May 1966 59 p refs Submitted for Publication Supported in part by the NSF
(IC-66/51)

Separate detailed discussions are presented on the following: the group SL(n,C) and its algebra; generalities on representations, finite and infinite representations of the algebra, group representations, multipliers, generalized tensors, and reduction of product representations. NSA

N66-35861# Oak Ridge National Lab., Tenn.
POSITRON ANNIHILATION IN METALS
Julian Crowell (Ph.D. Thesis—Vanderbilt Univ.) and R. H. Ritchie Jun. 1966 191 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1443) CFSTI: HC $5.00/MF $1.00

A theoretical study is made of the two-photon annihilation of positrons in metals in the approximation in which a metal is regarded as a free-electron gas in a smeared-out positive-charge background. The emphasis of the study is on calculations of the annihilation rate and on calculations of the static dielectric constant of an electron gas; although, some attention is also given to angular correlation, to the question of annihilation from a bound state, and to the question of whether the positron can be treated as a nonrecoiling particle in annihilation calculations. NSA

N66-35862# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
FORMATION OF ELECTRON-POSITRON PAIRS BY HIGH-ENERGY γ QUANTA [OBRAZOVANIE ELEKTRON-POZITRONNYKH PAR γ-KVANTAMI BOL'SHIKH ENERGII]
Ya. Bem, V. G. Grishin, and E. P. Kistenev 5 Apr. 1966 6 p refs In RUSSIAN Submitted for Publication
(JINR-P-2667)

Photoproduction of (e^+e^-)-pairs by γ quanta (E_γ=10–5000 Mev) was investigated with the help of a 24-liter propane bubble chamber. Experimental distributions in the quantity V (the ratio of the positron energy to that of a γ-quantum) agree with theoretical predictions. Author (NSA)

N66-35863# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
MEASUREMENT OF THE TOTAL IONIZATION INTENSITY NEAR THE GROUND AND SEPARATION OF THE VARIOUS COMPONENTS [MESURE DE L'INTENSITE TOTALE D'IONISATION AU VOISINAGE DU SOL ET SEPARATION DE SES DIFFERENTES COMPOSANTES]
Philippe Gravet (Ph.D. Thesis—Paris Univ.) 1966 58 p refs In FRENCH
(CEA-R-2880)

An investigation was made to measure the total amount of ion-pairs produced in the air per unit time and unit volume. It is possible, furthermore, by using continuous recording to study the variations in the ionization due to α, β, and γ radiation at a height of one meter. The apparatus which was developed consists of two chambers of 120 liters: one, hermetically sealed detects the γ component, the other with a circulation of the ambient air detects the α and γ; it is thus possible by difference to evaluate the α component. The chambers and the associated electronic equipment were designed for continuous operation in the open air. Another chamber without walls can be used for measuring directly to total ionization intensity and from this an approximate calculation may be made of the β component. A series of recordings was made near Saclay where the natural radioactivity level is moderate, and in regions of low and high activity (near the sea and in the CEA's mining divisions). It was thus possible to show the variation in the γ component as a function of the geographic position of the measurement (from 3.7 to 6.31 cm^3/sec), the very large variations of the α component at a given place with changing meteorological conditions (from 1.5 to 45 l/cm^3/sec at Saclay for example) and the far smaller variations in the β component. NSA

N66-35864# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik.
THE CHARGE-DEPENDENT NUCLEAR INTERACTION AND FERMI MATRIX ELEMENTS OF β DECAY
H. Schopper Mar. 1965 5 p refs
(KFK-313)

Deviations from charge independence of nuclear forces can be found by determining the Fermi matrix elements M_F of $\Delta T = \pm 1$ beta transitions from β–γ circular polarization correlations or beta asymmetries from polarized nuclei. Data on the β–γ circular polarization correlation of ^{34}Na, ^{41}Ar, ^{44}Sc, ^{52}Mn are used to derive the constants in expressions for M_F based on a charge-dependent nuclear potential model previously developed. The M_F values thus obtained are presented. NSA

N66-35865# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik.
A RE-EVALUATION OF THE COUPLING CONSTANTS IN BETA DECAY
H. Bushring (Physik. Inst., Heidelberg) and H. Schopper Feb. 1965 6 p refs
(KFK-307)

The f exact wave function was calculated for the neutron and for ^{14}O, using an exact solution of the Dirac equation taking electron screening into account; results are compared with those from previous calculations. Previously calculated values for radiative corrections and corrections for finite nucleon size and for competition from K capture are used to obtain values for total additional corrections to the f values. The final corrected f values are shown, and ft values are derived and used to calculate g_v and the axial vector coupling constant. NSA

N66-35873# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
ACCURACY OF PARTICLE TRAJECTORY LOCATION IN A SPARK CHAMBER [TOCHNOST VOSSTANOVLENIYA TRAEKTORII CHASTITSY V ISKPOVOI KAMERE]
Yu. D. Bayukov, Yu. M. Zaitsev, G. A. Leksin, and L. N. Sokolova 10 Apr. 1965 12 p refs In RUSSIAN; ENGLISH summary
(ITEF-341)

An accuracy of particle trajectory location as a function of the point position on a spark through which extrapolated lines are drawn is investigated. It is shown that the location of the point least removed from the trajectory of the particle—the alignment point—depends on the work conditions of the spark chamber and it is practically identical for the particles crossing the chamber at different angles. It is found that the mean square deviation at the point close to the alignment point is 0.2 mm for the particles crossing the chamber perpendicularly to the plates. It is proved that the straight line drawn by the least squares method is really the trajectory of the particle within the limits of the accuracy of the experiment. Author (NSA)

N66-35882# United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.
ETA AND NEUTRON CROSS SECTIONS OF ^{235}U FROM 0.03 TO 200 ev
F. D. Brooks, J. E. Jolly, M. G. Schomberg, and M. G. Sowerby Feb. 1966 17 p refs
(AERE-M-1670)

Measured values of eta, σ_T and σ_F and derived values of σ_C are given for ^{235}U from 0.03 to 200 ev. The averages of the cross sections and of eta and alpha have been calculated for a number of energy groups together with various ratios and integrals of these quantities which are of interest for reactor design studies. Comparisons are made between the results obtained in the present experiment and those from other laboratories. Author (NSA)

N66-35885# Oak Ridge National Lab., Tenn.
TRANSFER: A PROGRAM TO CALCULATE P_n MULTIGROUP SCATTERING MATRICES
C. W. Craven, Jr. and J. L. Lucius 9 May 1966 37 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1537) CFSTI: HC $2.00/MF $0.50

TRANSFER is a Fortran program which calculates multigroup scattering matrices in the P_n approximation for use in S_nP_n transport theory calculations and B_n spectral calculations. Pointwise total scattering cross sections and Legendre expansion coefficients of the angular distribution are reduced to narrow group averages by assuming a 1/E flux spectrum and numerically integrating the inscattering source term in the Boltzmann equation. The resulting multigroup transfer matrices are placed on punched cards. Author (NSA)

N66-35886# International Centre for Theoretical Physics, Trieste (Italy).
RENORMALIZED ω-ϕ MIXING ANGLE AND $J^P=1^-$ MESON DECAYS
R. J. Rivers 13 May 1966 9 p refs Submitted for Publication
(IC-66/50)

Field-theoretic arguments are used to define a renormalized ω-ϕ mixing angle and predictions are compared for the normalized and renormalized theories and experiment. The sensitivity of the predictions to the initial assumptions is briefly discussed. Author (NSA)

N66-35887# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DYNAMICAL SYMMETRY AND HADRON MASS SPECTRUM [DINAMICHESKAYA SIMMETRIYA I SPEKTR MASS ADRONOV]
D. Ts. Stoyanov and I. T. Todorov 15 Mar. 1966 26 p refs In RUSSIAN Submitted for Publication
(JINR-P-2621)

The semidirect product of the Poincare group with U(6,6) is considered in which the on-compact internal symmetry group U(6,6) is an invariant subgroup. The hadrons are classified in the "ladder" (unitary, infinite dimensional) representations of U(6,6). The mass-square operator is defined in terms of "dynamical" 4-momentum. A method of successive approximations is proposed for the calculation of its eigenvalues. The first approximation is in good agreement with experiment in the case of baryons while in the meson case the results are less satisfactory. Author (NSA)

N66-35888# International Centre for Theoretical Physics, Trieste (Italy).
CABIBBO ANGLE AND PARTIAL CONSERVATION OF AXIAL CURRENT
W. Krolikowski 16 May 1966 8 p refs Submitted for Publication
(IC-66/52)

A partial conservation condition for the total hadronic axial weak current is written in such a way that it determines the Cabibbo angle in a close agreement with experiment. Author (NSA)

N66-35889# California Univ., Livermore. Lawrence Radiation Lab.
RELAXATION PHENOMENA AND CHEMICAL CROSS SECTION
B. J. Alder 13 May 1966 25 p refs
(Contract W-7505-ENG-48)
(UCRL-14901-T) CFSTI: HC $1.00/MF $0.50

By following molecular trajectories on the computer it was possible to obtain much greater detail about molecular behavior in simple systems than is feasible experimentally. These studies, consequently, allow the validity of various theoretically proposed mechanisms to be evaluated. With respect to relaxation phenomena in fluids, it could be shown that the concept of an activation barrier to molecular flow is invalid. Instead, the van der Waals description of a fluid, in which the attractive part of the intermolecular forces is treated as a weak perturbation, led to remarkably accurate results. Comparison of the theory to experimental transport coefficients in dense systems of the rare gases was made by taking into account that the repulsive part of the intermolecular potential is soft. The chemical cross-section calculations are illustrated for the simplest possible case of the exchange reaction of hydrogen atoms with hydrogen molecules. These calculations involve in the first place an accurate quantum mechanical evaluation of the potential energy surface, which confirm the existence of a barrier, although of smaller height and width than earlier and cruder calculations. With the given potential surface, the trajectories for classical particles leading to a reaction were evaluated as a function of the relative velocity and of the vibrational and rotational state of the particles. Finally, it could be shown that a quantum mechanical calculation of the trajectories would not significantly affect the reaction rate predicted on a classical basis.
Author (NSA)

N66-35896# Oak Ridge National Lab., Tenn.
MEASUREMENT OF MASS ATTENUATION OF COEFFICIENTS USING 50-kvp TO 150-kvp X-RAYS
Billy Evon Foster (M.S. Thesis—Vanderbilt Univ.) Jun. 1966 58 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1457) CFSTI: HC $3.00/MF $0.50

Experimental determinations of the low-energy X-ray attenuation coefficients of some materials associated with nuclear technology were made to permit their use in homogeneity studies and various radiographic techniques. The materials examined were types 304 and 347 stainless steel, Zircaloy-2, type 1100 aluminum, and uranium–aluminum alloys of 7, 18.6, and 24.8 wt % U. A Norelco 150 X-ray unit was used as the source of radiation. The detector was a NaI(Tl) crystal, optically coupled to a photomultiplier tube. The equipment, its operation, and the experimental procedure are discussed in detail. Mass attenuation coefficients were determined as the summation of the fractional absorption caused by the significant constituent elements within the limits of predetermined energy ranges. Author (NSA)

N66-35897# California Univ., Berkeley. Lawrence Radiation Lab.
CORRELATIONS OF PHOTONS FROM A THERMAL SOURCE
Shang-keng Ma (Ph.D. Thesis) 21 Apr. 1966 111 p refs
(Contract W-7405-ENG-48)
(UCRL-16824) CFSTI: HC $4.00/MF $0.75

The amplitude and the intensity-correlation of photons from a model thermal source are studied. The objective is to express the photon correlation function in terms of the parameters describing the source. The source model is analyzed utilizing the temperature Green's function method. The power spectrum (line shape) is computed numerically for some special cases. General properties of temperature Green's functions are also studied. Author (NSA)

N66-35900# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
THE SPECTRAL DISTRIBUTION OF PHOTONS SCATTERED BY ELECTRONS BOUND IN THE K SHELL, PART II

M. A. Di Lazzaro and G. Missoni 21 Feb. 1966 80 p (ISS-66/7)

Measurements were carried out to find the spectral distribution of 662 keV γ-rays scattered by K shell electrons of gold and uranium. The spectral distribution of spurious events due to bremsstrahlung inside the target is compared with theoretical values. Spectral distribution of photons scattered by K shell electrons is compared with theoretical values obtained by means of different approximations from the Klein–Nishina formula; these values do not agree with experimental data. The differential cross section was calculated for the scattering by bound electrons whose initial state is described by a Dirac wave function in a Coulomb field. Results of this calculation are in fair agreement with experimental data. In the second part the spectral distribution of photons scattered by K shell electrons and the spectral distribution of spurious events are reported and discussed. Author

N66-35904# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

COULOMB FIELD AND NON-RELATIVISTIC SPACE QUANTIZATION [KULONOVSKOE POLE I NERELYATIVISTSKOE KVANTOVANIE PROSTRANSTVA]

R. M. Mir-Kasimov 17 Mar. 1966 15 p refs (JINR-P-2627)

A possibility is considered of describing a hydrogen atom in terms of the p-space of constant curvature. An analogy with space quantization treated by Snyder is drawn. Different ways of projective introduction of metric into the p-space are investigated. Author (NSA)

N66-35905# Oak Ridge National Lab., Tenn.

SEMI-CLASSICAL MODEL OF THE PHOTOELECTRIC EFFECT IN METALS

W. G. Connor (M.S. Thesis—Vanderbilt Univ.) and R. H. Ritchie Jun. 1966 86 p refs (Contract W-7405-ENG-26) (ORNL-TM-1458) CFSTI: HC $3.00/MF $0.75

Photoemission from a bounded, free-electron-like metal was treated on the basis of separate semi-classical models of surface and volume photoemission processes. It is proposed that the surface photoeffect may be considered the inverse of the transition radiation process. The vectorial effect in surface photoemission is related to the complete polarization of transition radiation in the plane of emission. This model leads to the prediction that electron yield from a thin foil should depend upon the thickness of the foil in an oscillatory way. The volume photoeffect is described on a phenomenological basis, relating photoelectron yield from a given metal with the response of the metal to photons, the cascade–transport process of nascent photoelectrons in the metal, and the transmission probability of these electrons at the surface of the metal. Comparison of calculated yields with published experimental data reveals only fair agreement between the results of different experimenters and between these data and the present theory. Reasons for the discrepancies are discussed. Author (NSA)

N66-35962*# Radio Corp. of America, Princeton, N. J.

STUDY OF INELASTIC ELECTRON–MOLECULE COLLISIONS Progress Report No. 1, 21 Mar.–30 Jun. 1966

[1966] 14 p refs (Contract NAS5-9303) (NASA-CR-77765) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A summary is presented of the theory being applied to the calculation of the rate of dissociative recombination of N_2^+ and which will be applied to the ion O_2^+. Partial results pertaining to N_2^+ are included. A study directed toward improvement of existing methods of calculating electronic transitions to continuum states of the nuclear motion is discussed. Author

N66-36092*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

THE APPLICATION OF PERTURBATION THEORY TOWARD THE DETERMINATION OF MOLECULAR ENERGIES AND PROPERTIES

Robert L. Matcha 15 Oct. 1965 209 p refs Submitted for Publication in Two Parts (Grant NsG-275-62) (NASA-CR-68530; WIS-TCI-129) CFSTI: HC $6.00/MF $1.25 CSCL 20H

The ground state energy of the hydrogen molecule is accurately determined with the aid of Rayleigh Schroedinger perturbation theory, treating the electronic interaction as a perturbation to the remaining Hamiltonian. Techniques are developed for evaluating integrals containing zeroth order H_2^+ wave functions. A generalized Hylleraas variational method is used to determine wave functions beyond zeroth order. The perturbation energy through fifth order at the equilibrium separation is found to be comparable in accuracy to the most accurate variational calculations. Author

N66-36096*# Columbia Univ., New York. Radiation Lab.

LIFETIMES AND G_J FACTORS IN EXCITED STATES OF CHROMIUM. HYPERFINE STRUCTURE OF Cr^{53}

H. Bucka, B. Budick, R. J. Goshen, and S. Marcus [1965] 34 p refs Submitted for Publication (GRANT NsG-360; Contract DA-36-039-SC-90789) (NASA-CR-68489) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The ^7P terms of two excited chromium configurations have been studied by the techniques of level crossing and double resonance spectroscopy. The lifetimes of the J levels of the two terms were found by observation of the Hanle effect to be $(3.4\pm0.5)\times10^{-8}$ sec and $(6.51\pm0.9)\times10^{-8}$ sec for $(3d^54p)^7P_4$ and $(3d^44s4p)^7P_4$ respectively. The g_J values for the three J levels of the $(3d^54p)^7P$ term were also determined; g(J=4) = 1.7512 (3), g(J=3) = 1.9178(2), and g(J=2) = 2.3351(3). Author

N66-36097*# Columbia Univ., New York. Radiation Lab.

CORE POLARIZATION IN CHROMIUM-53

B. Budick, R. J. Goshen, S. Jacobs, and S. Marcus [1965] 24 p refs Submitted for Publication (Grant NsG-360; Contract DA-36-039-SC-90789) (NASA-CR-68494) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Theoretical and experimental values for the contribution of core polarization to the hyperfine structure of excited states of chromium-53 are compared. A theory is developed for extracting the core contributions to the magnetic field from the measured hyperfine constants. It is necessary to take account of configuration interaction with an actual configuration of unpaired s electrons. A value of −525,000 G is deduced for the magnetic field at the nucleus produced by core polarization. The − sign indicates that this field is antiparallel to the net spin of the atom. This is compared with theory and with the results of other experiments. Corrections due to relativity, the second-order Zeeman effect, and the breakdown of LS coupling are considered. Author

N66-36151# Polish Academy of Sciences, Warsaw.

BETA-RAY SCATTERING [ROZPRASZANIE PROMIENI BETA]

Ryszard Szepke 1966 52 p refs In POLISH; ENGLISH summary (INR-689/XV/I) CFSTI: HC $3.00/MF $0.50

The investigations demonstrate the change of distribution of back-scattered beta-rays and material distinguishing versus fall and reflection angles. There is also studied the standard error of coating thickness measurements against angular distribution and geometric system of the detecting head. Some remarks are made on influence of collimating of the beam-rays, and of ruggedness of irradiated surface. A review of 82 references is included. Author

N66-36158# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
INVESTIGATION OF PNC EFFECTS IN THE RADIATIVE CAPTURE OF POLARIZED NEUTRONS—THE CASE OF $H^2(n,\gamma)$ AND $Cd^{113}(n,\gamma)$
M. Forte and O. Saavedra Jul. 1966 14 p refs Presented at the Intern. Conf. on Nucl. Struct., Antwerp, 19–23 Jul. 1965
(EUR-3053-e) CFSTI: HC $1.00/MF $0.50

Parity non-conservation in nuclear electromagnetic interactions may produce interference effects with linear intensity in the F parameter. We have investigated them in the gamma transitions following the capture of polarized neutrons, respectively with H^2 and Cd^{113} targets. The (n,γ) target was exposed to a polarized neutron beam obtained from the magnetic mirror installed at the Ispra I reactor. In the case of $H^2(n,\gamma)$, the corrected asymmetry parameter, evaluated for the 7.25 MeV capture gamma-rays, was $\alpha=(0.45\pm2.5)\ 10^{-4}$. From this result we may simply assign an upper limit to the PNC parameter: $F\leq3.10^{-6}$. In the case of Cd^{113} (n,γ), we considered both a range of the gamma spectrum containing mainly the transition to the 0^+ ground state of Cd^{114} and a group of transitions of the first few excited levels of Cd^{114}, all having + parities. In both cases, the corrected α value was within the standard error, which had an order of magnitude of 10^{-4}. Thus the present measurement does not confirm the existence of an asymmetry. Author

N66-36187# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
PROTON ELASTIC SCATTERING ON DEUTERONS AT LARGE ANGLES
Yu. D. Bayukov, D. S. Vorob'ev, G. A. Leksin, V. B. Fedorov, and V. D. Khovanskii 1965 7 p refs In RUSSIAN; ENGLISH summary
(ITEF-361)

The proton–deuteron136.3° L.s. elastic scattering differential cross sections at the energies of incident protons 715 MeV ($\Theta_{c.m.}$ = 157.5°), 1000 MeV ($\Theta_{c.m.}$ = 160°), 3660 MeV ($\Theta_{c.m.}$ = 169.5°) have been measured and they are equal:

$$(26.3\pm8.0)\ \frac{\text{microbarn}}{\text{ster}},\quad (17.7\pm4.3)\ \frac{\text{microbarn}}{\text{ster}},$$

$$(3.1\pm3.1)\ \frac{\text{microbarn}}{\text{ster}}$$

respectively in c.m.s. The results are discussed within the framework of the pole graph with the neutron exchange.
Author (NSA)

N66-36188# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
A NEW ISOTOPE, ^{174}W
I. Demeter, Kim Hon Sil, E. Nadjakov, and N. G. Zaitseva 1965 18 p refs Submitted for Publication
(JINR-E-2360)

The isotope ^{174}W is obtained after irradiation of an erbium target with ^{12}C ions. ^{174}W is identified using its genetic relation with ^{174}Ta. The half-life of ^{174}W is measured to be 31±2 min. Author (NSA)

N66-36189# Eidgenossische Technische Hochschule, Zurich (Switzerland).
[STUDIES IN PARTIAL PHYSICS] Progress Report
R. W. Meier, ed. (Swiss Federal Inst. for Reactor Res., Wuenlingen) Apr. 1965 16 p refs
(EANDC(OR)-40L)

Tritium—deuteron reactions (d,n) on, differential cross sections for; Deuterons—reactions with tritium (d,n), differential cross sections for; Neutrons—scattering by carbon and nitrogen of 14-Mev, inelastic; Carbon—neutron scattering at 14 Mev by, inelastic; Nitrogen—neutron scattering at 14 Mev by, inelastic; Deuterium—neutron reactions (n,2n) at 14 Mev, spectra for; Neutrons—reactions with deuterium (n,2n) at 14 Mev, spectra for; Neutron Spectra—measurements from neutron reactions (n,2n) with deuterium at 14 Mev; Neutrons—polarization of deuteron-scattered; Calcium Ca-40—neutron reactions (n,α) on, differential cross sections for; Neutrons—reactions with calcium-40 (n,α), differential cross sections for; Dysprosium—neutron cross sections for, at 0.01 to 10 ev; Lutetium—neutron cross sections for, at 0.01 to 10 ev. NSA

N66-36201# Bettis Atomic Power Lab., Pittsburgh, Pa.
MONTE CARLO METHODS FOR THE CALCULATION OF THERMAL NEUTRON FLUXES
E. M. Gelbard Mar. 1966 20 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-T-1835, Rev.)

Monte Carlo codes for calculating thermal-neutron fluxes are discussed. Some of the methods that are used to treat specific problems are outlined. NSA

N66-36202# Joint Inst. for Nuclear Research, Dubna (USSR).
NUCLEON–NUCLEON POTENTIAL WITH A SOFT CORE FOR THE $^1S_0$ STATE IN THE ENERGY REGION 0.17–310 MeV
I. Bystritskii, F. Legar, and I. Ulegla 1965 6 p refs Submitted for Publication
(JINR-E-2440)

Nucleon–nucleon potentials with a soft core, giving a good description of the energy dependence of the $^1S_0$ state phase shifts in elastic p–p and n–p scattering, are found. However, at low energies the simultaneous description of p–p and n–p scattering in the $^1S_0$ state with the help of a single potential is in disagreement with the experimental data. Author (NSA)

N66-36203# California Univ., Berkeley. Lawrence Radiation Lab.
CONSIDERATIONS AFFECTING THE DESIGN OF ATOMIC-BEAM AND MOLECULAR-BEAM APPARATUS
Douglas Mc Colm 17 May 1965 25 p refs
(Contract W-7405-ENG-48)
(UCRL-11670) CFSTI: HC $1.00/MF $0.50

Optimum design criteria for atomic- and molecular-beam apparatus are discussed, and signal strengths under a number of conditions are calculated. Signal strength and signal-to-noise ratios are shown graphically as functions of the design parameters. Vertical-slit geometries only are considered. Author (NSA)

N66-36204# Michigan Univ., Ann Arbor.
CONFIGURATION INTERACTION IN TWO-ELECTRON AND THREE-ELECTRON ATOMS
Robert Theodore Brown (Ph.D. Thesis) 1965 147 p refs
(Contract AT(11-1)-1112)
(TID-22957) CFSTI: HC $4.00/MF $1.00

A theory for configuration interaction was developed and used to determine the $2\,^2P$-energy state of lithium. Comparisons were made with ground state determinations for two-electron atoms and the 2^2 S-state of lithium. NSA

N66-36205# California Univ., Livermore. Lawrence Radiation Lab.
IONS AND DISSOCIATION PRODUCTS OBTAINED FROM A HYDROGEN RF ION SOURCE
E. S. Chambers 23 Jun. 1965 6 p refs
(Contract W-7405-ENG-48)
(UCRL-14271) CFSTI: HC $1.00/MF $0.50

Low-intensity ions from an r-f-excited hydrogen ion source and their dissociation products from collision with H_2 molecules were investigated through the apparent mass range from 0 to 3.9. Along with the normally expected ions, the following were observed: H_3^{2+} and its dissociation products H_2^+ and H^+; H^+ from dissociation of H_4^+, H_5^+, H_6^+, OH^+ and O_2H^+; HD^+ from H_2D^+; B^{2+} from $B_2O_4^+$; and N^{2+}, N^{3+}, N^{4+}, N^{5+} from N_2^+. A number of additional ions were observed but not identified. Author (NSA)

N66-36210# AVCO-Everett Research Lab., Everett, Mass.
NEUTRAL ATOM BREMSSTRAHLUNG
B. Kivel Jun. 1966 46 p refs Submitted for Publication
(Contract AF 29(601)-7055)
(RR-247; AD-636034) CFSTI: HC $2.00/MF $0.50

Predictions are given for the bremsstrahlung absorption cross section of atomic oxygen and atomic nitrogen. The electron–atom interaction potential energy is adjusted to give agreement with the photo-absorption measurements of the negative oxygen ion. The exchange force is treated in an approximate manner following a suggestion by Slater but adjusted to take account of the dependence on the configuration of the electron wave. The difference in the exchange force for s and p-waves as well as the difference between the triplet and quintet configurations in atomic nitrogen must be preserved to obtain predictions for the bremsstrahlung which are in agreement with experiments. The atomic oxygen absorption cross section is about a factor 5 less than that of atomic nitrogen in agreement with the measurements of Taylor. The Maxwell average atomic nitrogen bremsstrahlung absorption cross section is insensitive to temperature. The atomic nitrogen cross section deviates somewhat from the Kramers wavelength dependence becoming relatively larger in the blue. Author (TAB)

N66-36212# Illinois Univ., Urbana. Dept. of Physics.
OBSERVATION OF THE TWO-PHOTON DECAY OF THE K^0_2 MESON
L. Cregee, J. D. Fox, H. Frauenfelder, A. O. Hanson, G. Moscati et al [1966] 10 p refs Sponsored by AEC, NSF, and ONL
(COO-1195-61; AD-634721) CFSTI: HC $1.00/MF $0.50

An arrangement of spark chambers and scintillation shower detectors was used to investigate the two-photon decay mode of the K^0_2 meson. We found 29 candidates for this decay mode. However, 12 ±7 of these events can originate from the $K^0_2 \rightarrow \pi^0\pi^0\pi^0$ mode and the CP-violating $K^0_2 \rightarrow 0\pi^0$ decay. Monte Carlo simulations indicate that 5 ±2 of the 12 events are likely to originate from the $3\pi^0$ decays, leaving 7 ±7 events which may be ascribed to $2\pi^0$ decays. The corresponding branching ratios are: Rate $(K^0_2 \rightarrow 2\gamma)$/Rate $(K^0_2 \rightarrow$ all modes) $= (1.3 \pm 0.6) \times 10^{-4}$; Rate $(K^0_2 \rightarrow 2\pi^0)$/Rate $(K^0_2 \rightarrow$ all modes) $= (1.2\,^{+1.5}_{-1.2}) \times 10^{-3}$. Author (TAB)

N66-36267# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
ALGEBRA OF CURRENTS BASED UPON $SU_W(6)$ GROUPS
M. P. Khanna and S. Okubo 21 Jan. 1966 21 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-115)

Some consequences based upon the algebra of currents of $SU_W(6)$ group have been investigated. A method is used to reproduce almost all of the conventional SU(6) results without explicitly assuming its validity. Author

N66-36288# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE CONSTRUCTION OF A GENERAL SOLUTION OF THE SYSTEM OF MULTIGROUP TRANSPORT EQUATIONS
L. D. Ivanov [1966] 9 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), no. 3, 1966 p 58–62

One of the versions of the proof of the theorem on the completeness of eigenfunctions in the ranges of variation (-1,1) and (0,1) of the angular variable is considered. The results may be used to determine the critical size of a plane reactor and to solve the Milne problem in a multigroup approximation. The question of the completeness of the eigen functions of a system of multigroup transport equations has been discussed previously. However, the method of regularizing the system of singular integral equations used in the proof of the theorem is too complicated. A simpler completeness proof is expounded. Author

N66-36348# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
THE STRUCTURE CORRECTIONS TO THE HYPERFINE SPLITTING OF THE HYDROGEN ATOM
F. Guerin (Ph.D. Thesis—Paris Univ.) Jul. 1966 40 p refs
(TH/163) CFSTI: HC $2.00/MF $0.50

The influence of the proton structure on the hyperfine splitting appears in the exchange of two high-momentum photons between the electron and the proton. The contribution of the intermediate states involving π-mesons together with the proton are evaluated: the π-nucleon S-wave is found to contribute to 1 p.p.m., and all the known π-nucleon resonances to a value smaller than 1 p.p.m. The exchange of an 1^+ meson between the electron and the proton is studied by means of two graphs: the effect is found to be 0.1 p.p.m. One concludes that, in the present state of our knowledge, the effects of the proton structure cannot be blamed for the discrepancy between the theoretical and experimental hyperfine splitting. Author

N66-36381# European Organization for Nuclear Research, Geneva (Switzerland).
LECTURES ON BEAM OPTICS
B. de Raad, A. Minten, and E. Keil 23 Jun. 1966 66 p refs Presented at Acad. Training Program, Geneva, 1965
(CERN-66-21)

Equations and general concepts of beam optics are presented for use in designing beams for a proton synchrotron. In these beams the angles between the particle trajectories and the axis of the beam transport system are of the order of 10^{-2} radian, so that the tangents and sines can be taken as equal to the angles themselves with high accuracy. Various lectures are included in related areas such as low-energy separated beams, and the k_4 beam is given as an example. Radio frequency separated beams are discussed with regard to formulae, pre- and post-cavity optical systems, background considerations, collimator arrangement, and comparison with electrostatic separators. S.P.

N66-36399# Stanford Univ., Calif. High Energy Physics Lab.
NEUTRON FORM FACTORS FROM INELASTIC ELECTRON SCATTERING IN TRITIUM AND HELIUM-3

E. B. Hughes, M. R. Yearian, and R. Hofstadter May 1966 23 p refs Submitted for Publication
(Contract Nonr-225(67))
(HEPL-443; AD-634756) CFSTI: HC $1.00/MF $0.50

Measurements are reported of the inelastic scattering of electrons from the mirror nuclei of tritium and helium-3. The ratio of the quasi-elastic electron–tritium and electron–helium-3 cross sections was measured to a precision of about 3% for values of the square of the four-momentum transfer, equal to 2.5 and 4.6/F^{-2}. Detailed measurements of the shape of the entire inelastic spectra and estimates of the total inelastic cross sections were made. While these data are primarily intended to furnish additional experimental information which will be of use in determining the structure of the three-body nuclei, it is also pointed out that such data are a possible source of information on the structure of the neutron.
Author (TAB)

N66-36408# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
PHOTODISINTEGRATION OF LITHIUM SIX AT HIGH ENERGY
E. Allton, S. Ferroni, V. G. Gracco, B. Merkel (Ecole Normale Superieure, Orsay, France), and C. Schaerf 24 Jun. 1966 11 p refs *Its* Nota Interna No. 326
(LNF-66/32) CFSTI: HC $1.00/MF $0.50

A target of enriched lithium six was bombarded by an electron beam, and the resulting deuterons were reacted with gamma radiation. The electron beam was momentum analyzed by a three magnet deflecting system, and the deuterons emitted from the target were also momentum analyzed by a magnetic spectrometer. Information on the incoming gamma ray energy was obtained by measuring a yield curve as a function of the primary electron energy and integrating the cross section over the bremmstrahlung spectrum. Results were compared with a crude model, taking into account only the coherent photoproduction of π^0 on virtual deuterons. The measurements were performed at a constant angle and momentum for the outgoing deuteron, varying the primary electron energy. Diagrams of the photodisintegration reaction are given, along with graphs of the geometrical efficiency factor and the yield curve.
E.A.O.

N66-36424*# Oak Ridge National Lab., Tenn.
NEUTRON PHYSICS DIVISION Annual Progress Report, Period Ending 31 May 1966
F. C. Maienschein, A. D. Callihan et al Sep. 1966 42 p refs
(NASA Order R-104; Contract W-7405-eng-26)
(NASA-CR-77961; ORNL-3973, Vol. II) CFSTI: HC $2.00/MF $0.50 CSCL 20H

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1. THEORETICAL STUDIES FOR HIGH-ENERGY RADIATION SHIELDING R. G. Alsmiller, Jr. et al 14 p refs
2. EXPERIMENTAL STUDIES FOR HIGH-ENERGY RADIATION SHIELDING F. E. Bertrand et al 11 p refs
3. RADIATION DETECTOR STUDIES (II) R. W. Peelle et al 8 p refs

N66-36425# Columbia Univ., Irvington, N. Y. Nevis Labs.
A MEASUREMENT OF THE K_1^0 LIFETIME
L. Kirsch and P. Schmidt Feb. 1966 17 p refs
(Contract AT(30-1)-1932)
(R-539; CU-252; NEVIS-146)

Based on about 5000 K^0 decays into two charged pions in a hydrogen bubble chamber, we have measured the K_1^0 lifetime to be $\tau_1 = (0.843 \pm 0.013) \times 10^{-10}$ sec.
Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-35382# California Inst. of Tech., Pasadena.
PULSE STIMULATED RADIATION FROM A PLASMA AT HARMONICS OF THE GYROFREQUENCY
Wilhelm H. Kegel Jun. 1966 26 p refs
(Contract Nonr-220(50))
(TR-32; AD-635155) CFSTI: HC $1.00/MF $0.50

A magneto-plasma excited by two short pulses at the gyrofrequency or a multiple thereof, is considered in the single particle approach. After the second pulse radiation, maxima arise at the gyrofrequency and its harmonics. In a situation where the time separation of these maxima is τ^* (in the simplest case $\tau^* = \tau$) at the fundamental, it is τ/n at the n-th harmonic. As the resonances at the harmonics are a finite larmor radius effect, excitation of these frequencies requires an initial energy. As an example, the case is studied where the first pulse has the gyrofrequency while the second has the frequency $2(\omega_c - 2\omega_{c_1})$. In this case radiation maxima arise with $2\omega_c$ at times $t_l = l\tau$ sub $l = \tau(\tau)$ ($l = 1,2,3,...$) after the second pulse. At the fundamental the maxima arise at times $t_l = (2l-1)\tau$ sub $l = 92l-1)\tau$, where the maximum at the time τ is initially due to the nonlinearity during the second pulse.
Author (TAB)

N66-35461# General Motors Corp., Indianapolis, Ind. Allison Div.
RESEARCH ON PLASMA PROPERTIES OF MAGNETO-PLASMADYNAMIC POWER GENERATORS Final Technical Report, 1 May 1963–30 Apr. 1966
Theodore L. Rosebrock, Robert L. Koch, Donald L. Tipton, Ronald O. Whitaker, Richard T. Schneider et al 31 May 1966 100 p refs
(Contract Nonr-4104(00); ARPA Order 420)
(EDR-4637; AD-635459) CFSTI: HC $4.00/MF $0.75

The initial objective of the program was to obtain basic information on the plasma properties of working fluids for magnetoplasmadynamic (MPD) power generators. The experimental portion of this initial program centered on a closed plasma diagnostic loop through which helium seeded with cesium was circulated. Test section temperatures were variable between 1000 and 1800°K. New spectroscopic techniques and methods of evaluating observed spectra were developed. The theoretical approach to the problem consisted of developing a mathematical model to describe nonequilibrium plasmas together with supplementary theoretical analyses to aid in design of improved MPD power generators. Instabilities occurring in the plasma flow were treated analytically. Redefinition of program objectives resulted in the demonstration of nonequilibrium ionization in a closed-loop generator operating at 1800° K. The working fluid was helium seeded with cesium. The power output accompanying the nonequilibrium ionization was on the order of a few watts. The severe reduction in power level below theoretical predictions was due to Hall shorting within the generator.
Author (TAB)

N66-35563# Brown Univ., Providence, R. I. Div. of Engineering
PERTURBATION METHODS FOR OBTAINING DIFFERENTIAL PHASE SHIFTS IN A CIRCUMFERENTIALLY MAGNETIZED FERRIT PHASE SHIFTER
R. E. Eaves, Jr. and D. M. Bolle Jun. 1966 42 p refs
(Contract AF 19(628)-5846; Grant NSF GK-204)
(AF-5846-1; AFCRL-66-402; AD-634992) CFSTI: HC $2.00/MF $0.50

The problem considered is the differential phase shift produced by a circumferentially magnetized tube of ferrite coaxially located in

a circular waveguide operating in circularly symmetric TE modes. A general perturbational formula is developed for differential phase shift in waveguides containing arbitrary anisotropic media and is then applied to the stated problem. Numerical results are presented and compared to those obtained from an exact solution.

Author (TAB)

N66-35659*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

ESTIMATES OF NONEQUILIBRIUM IONIZATION PHENOMENA IN THE INVISCID APOLLO PLASMA SHEATH

M. G. Dunn, J. W. Daiber, J. A. Lordi, and R. E. Mates Washington, NASA, Sep. 1966 64 p refs

(Contract NAS5-3976)

(NASA-CR-596) CFSTI: HC $2.50/MF $0.75 CSCL 20I

Estimates of nonequilibrium ionization phenomena in the asymmetric plasma sheath were made for an Apollo-type body entering the earth's atmosphere at superorbital velocity. For an entry velocity of 30,000 ft/sec and an attack angle of 20°, results are presented for altitudes of 200,000 ft and 250,000 ft, for the pitch plane. The charged species are taken as N_2^+, O_2^+, NO^+, N^+, O^+ and e^-. The chemical model employed permits three-body recombination reactions, two-body dissociative-recombination reactions, charge-exchange reactions, and ion-atom-exchange reactions. With the exception of the body stagnation point and a relatively small region on the body surface, the plasma-sheath fluid is found to be in a nonequilibrium state. The dominant electron-depletion reactions are shown to be $NO^+ + e^- \rightarrow N + O$, $N_2^+ + e^- \rightarrow N + N$, $N^+ + e^- + e^- \rightarrow N + e^-$, and $O^+ + e^- + e^- \rightarrow O + e^-$. Contours of electron density in the forebody and near afterbody region are presented for altitudes of 200,000 ft. and 250,000 ft. The electron density distribution and the collision frequency distribution for two selected paths through the plasma sheath are presented. The attenuation for the propagation of one-dimensional plane waves along these two paths is presented. The implication of these results is that for the particular trajectory position and transmission paths selected it would be exceedingly difficult to communicate with the craft at a carrier frequency in the range of 1 to 10 Gc.

Author

N66-35691# United Kingdom Atomic Energy Authority, Culham (England). Research Group

STEADY STATE MODEL OF CUSP LOSSES

J. B. Taylor Mar. 1966 14 p refs

(CLM-R58) HMSO: 1s 2d

When space charge fields can be neglected the loss of charged particles from a cusped magnetic field can be calculated exactly from a steady state statistical model without any restrictive assumptions about the form of the equilibrium configuration. Losses calculated in this way represent an upper limit for the loss from a Maxwellian plasma. In a spindle shaped cusp it is found that the loss through the line (ring) cusp corresponds, as expected, to a leak whose width is approximately a Larmor radius. However a comparable loss occurs through the point cusp, where it corresponds to a leak which is much larger than a Lamor radius. This enlargement is not very important for the spindle cusp itself, which in any case has a large loss from the ring cusp, but a similar enlargement could greatly increase the end-losses from a high-β θ pinch.

Author

N66-35728*# Maryland Univ., College Park. Center for Atmospheric and Space Physics.

A FIRST ORDER TECHNIQUE FOR THE MEASUREMENT OF VEHICLE POTENTIAL IN THE IONOSPHERE

Richard T. Bettinger Aug. 1965 16 p refs Presented at the Western Meeting of the Am. Geophys. Union, Dallas, Sep. 1965

(Grant NGR-21-002-057)

(NASA-CR-68767; TR-497) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Under certain conditions, the potential of vehicles immersed in the ionospheric plasma can become very large. In addition, the presence of on-board equipment (e.g., dc sweeps) often gives rise to significant variations in this potential. The use of a small diameter, cylindrical Langmuir probe is suggested as a means of measuring the artificially induced variations of potential with good accuracy. This technique will also provide crude information (approximately 1 V) on the vehicle potential as controlled by the geophysical parameters.

Author

N66-35788*# Harvard Coll. Observatory, Cambridge, Mass. Shock Tube Spectroscopy Lab.

THE CALCULATION OF CHEMICAL AND IONIZATION EQUILIBRIUM IN A CONVENTIONAL SHOCK TUBE

Scientific Report No. 12

John C. Rich and Judith C. Flagg Jul. 1966 24 p refs

(Grant NsG-438; Contract Nonr-1866(48))

(NASA-CR-77642) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The equations describing a plasma in local thermodynamic equilibrium are presented and applied to a conventional shock tube. If conditions of local thermodynamic equilibrium exist, these equations give the number densities of the atoms, molecules, ions and electrons that make up the plasma. For practical results an effective iteration scheme is presented for the computer solution of such equations.

Author

N66-35789*# Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences.

PULSED ELECTROMAGNETIC GAS ACCELERATION

Eighth Semiannual Progress Report, 1 Jan.–30 Jun. 1966

Robert G. Jahn and Woldemar F. von Jaskowsky 1 Jul. 1966 68 p refs *Its* Rept.-634g

(Grant NsG-306-63)

(NASA-CR-77643) CFSTI: HC $3.00/MF $0.75 CSCL 20I

Profiles of electric field distribution within the propagating current sheet of a dynamical pinch discharge were determined by a coaxial double electric probe. An improved piezoelectric pressure probe was developed which reduces the initial signal risetime below 1 μsec, yet more faithfully reproduces the pressure profile through and behind propagating current sheets after the initial impact signals. High resolution voltage records were obtained with outer and inner dividers and a "D-loop" which permit evaluation of the very low resistance of the discharge plasma and provide insight into the breakdown initiation mechanism. A gas laser interferometer was constructed for determining electron density distributions which arise near the current sheets during the pulsed plasma acceleration processes. The microwave reflection interferometer technique was extended to two modes which yield additional information on these electron density profiles. Prototype units of low-inductance capacitors for assembly into pulse-line configurations were constructed, and performed satisfactorily in initial tests. Studies of the ejection of pulsed plasmas from orifices were expedited by a large plexiglas exhaust tank, and a mechanized carriage capable of precisely aligning a battery of magnetic probes in the exhaust plume region.

Author

N66-35886# California Univ., Livermore. Lawrence Radiation Lab.

THE RANDOM PHASE APPROXIMATION

Stephen E. Bodner 11 Jun. 1965 10 p refs

(Contract W-7405-ENG-48)

(UCRL-14246) CFSTI: HC $1.00/MF $0.50

Generalized harmonic analysis is used to prove that there is a rapid phase variation in the Fourier transform of functions for which the correlation distance is small compared to the box size. In the limit of infinite box size, the Fourier transform has infinite derivative and zero correlation length in k-space. However, it is shown that one cannot neglect terms in an equation by an appeal to this rapid phase variation.

Author (NSA)

N66-35958*# National Aeronautics and Space Administration, Washington, D. C.

PRODUCTION OF HIGH PLASMA VELOCITIES BY HEATING AND SELF-MAGNETIC ACCELERATION IN ELECTRIC ARCS [ERZEUGUNG HOHER PLASMAGESCHWINDIGKEITEN DURCH HEIZUNGUND EIGENMAGNETISCHE BESCHLEUNIGUNG IN LICHTBOEGEN]

Th. Peters and K. Ragaller Aug. 1966 44 p refs Transl. into ENGLISH of Deut. Versuchsanstalt fuer Luft- und Raumfhart Rept.-372, Oct. 1964 p 1–41

(NASA-TT-F-10253) CFSTI: HC $2.00/MF $0.50 CSCL 20 I

Investigations are discussed on the increase in velocity of plasma jets by self-magnetic acceleration in electric arcs, using arc chambers in which the working gas is heated and then quasi-adiabatically expanded in an expansion nozzle. The arc operates not only inside the arc chamber at nearly constant pressure but also inside the expansion nozzle. Two modes of plasma acceleration are described: (1) heating of the plasma by the Joule heat produced in the arc; (2) magnetic acceleration produced by cooperation of current density and self-magnetic field (Lorentz forces). A device for realizing both effects, with the arc operating stably in an expanding supersonic flow at low and regular pressures, is described, with graphs showing the Lorentz forces in a plasma pinch, plasma jets with heating between cathode and anode, design of expansion nozzles of the cascade type, sketch of a device for rapidly expanding plasma flows, with plasma burner and auxiliary anode, etc. A comparison of magnetic acceleration for plasma engines with electrothermal engines, for various velocity ranges, is included. Author

N66-36016# General Electric Co., Philadelphia, Pa. Missile and Space Div.

NONLINEAR SCATTERING OF A LASER BEAM FROM A PLASMA

C. M. Tchen Jul. 1966 31 p refs

(R66SD40)

The incoherent scattering is investigated by means of a quasilinear method. First, the stationary spectrum of the scattered radiation, in a collision free plasma without a magnetic field, is studied. Second, the extension of the method to a quasi-stationary plasma determines the decay and growth of the scattered radiation. The Landau damping is found from a simplified basis, and is shown to play an important role in the stationary and non-stationary spectra. Finally, the scattering by plasma instabilities is treated by solving the system of equations governing the growth of the wave and the diffusion of the unstable distribution function of the trapped particles. Author

N66-36073*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

A UNIFIED TREATMENT OF THE RELAXATION PHENOMEN IN RADIATING ARGON PLASMA FLOWS BEHIND INCIDENT AND BAD SHOCK WAVES

Peter E. Oettinger Jul. 1966 123 p refs */ts* Inst. for Plasma Res. Rept.-86

(Grant NGR-05-020-091)

(NASA-CR-77861; SUDAAR-285) CFSTI: HC $4.00/MF $1.00 CSCL 20I

The electronic relaxation of a shock heated, nonequilibrium argon plasma flow is treated by means of a combined theoretical and experimental investigation. A physical model of the flow is postulated which includes the microscopic collisional and radiative processes. When coupled with the macroscopic conservation laws, this leads to a rigorous formulation of the equations governing the relaxing flow. A resultant numerical solution for the flow behind a strong incident shock front propagating into argon gas is compared to time-resolved interferograms. Good agreement is obtained between theory and experiment for incident shock Mach numbers of 11 to 18 propagating into argon at pressures of 3 to 5 mm Hg. The experimental investigation is extended into the argon shock layer preceding a cylinder-plate. An attempt is made to use the formulated equations to predict conditions along the stagnation streamline, when the flow can either be considered one-dimensional or at constant density across most of the shock layer. Comparison of the experimental and theoretical results show that neither one of these postulated flows actually exists. Author

N66-36100*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PRIMARY AND AFTERGLOW EMISSION FROM SUPERCOOLED NITROGEN EXCITED BY FAST ELECTRONS

Daniel I. Sebacker [1965] 18 p refs

(NASA-TM-X-56985) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Measurements were made of the primary and afterglow emission lifetimes of some of the emitting species in an expanded nitrogen flow at 16° K and 30 microns Hg when excited by a 10 kV electron beam. Both the first negative system of N_2^+ and the second positive system of N^2 were observed in the afterglow to persist in the order of 2×10^{-6} seconds. The afterglow was swept downstream of the beam by the high velocity nitrogen stream so that it could be observed independent of the primary emission. The origin of the afterglow is explained by the possible transfer of energy from ground state N_2^+ ions and secondary electrons to ground state N_2 molecules. This is substantiated by observations of the departure from a Boltzmann distribution of the rotational energies in the N_2 molecules. In air, the afterglow was greatly quenched by the O_2 molecules and in nitrogen at a temperature above supersaturation no afterglow was observed. Author

N66-36139*# National Aeronautics and Space Administration, Washington, D. C.

VELOCITY OF A PLASMA JET [SKOROST' PLAZMENNOY STRUI]

F. B. Yurevich and M. V. Volk-Levanovich Sep. 1966 13 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz.-Tekh. Navuk (Minsk), no. 1, 1966 p 125–128

(NASA-TT-F-10291) CFSTI: HC $1.00/MF $0.50

Discussion of a procedure for measuring the velocity of a plasma jet ejected from an electric-arc device. The procedure consists of recording brightness fluctuations of the jet, which for subsonic flows can be identified with the velocity of the jet. Author

N66-36146# United Kingdom Atomic Energy Authority, Culham (England).

SOME FACTORS INFLUENCING THE CONTAINMENT OF A CUSP PLASMA

G. D. Hobbs and I. J. Spalding Mar. 1966 21 p refs

(CLM-R-57) HMSO: 2s 6d

A survey of some of the factors influencing the containment of a plasma in cusp geometry is presented, with particular emphasis on the effects arising from the presence of walls or plasma outside the containment volume. The effects of wall short-circuits on both the collision-free hole size and ion-ion collisional diffusion are considered. Space charge limitations of the electron thermal conduction loss are also discussed. A simple two-fluid MHD model of the SPICE II cusp compression experiment is described. Its predictions are found to agree with observation to within a factor of two, which is within the experimental uncertainty of the initial plasma conditions. Author

N66-36207# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.

WAVES IN A HOT ELECTRON-HOLE PLASMA Scientific Report No. 2, 1 May 1965–31 Jan. 1966

J. M. Mayr 1 Apr. 1966 20 p refs

(Contract AF 61(052)-888)

(AFCRL-66-439; AD-634926) CFSTI: HC $1.00/MF $0.50

The propagation of waves in a hot, magnetized electron-hole plasma is studied. The direction of wave propagation and the ratio of masses of the particles are arbitrary. The electron and hole densities are not necessarily equal but are constant throughout all space. Thermal motion is taken into account by a pressure term in the equations of motion. Detailed dispersion curves are calculated for those parameters which characterize indium antimonide at 77°K. Various particle densities and directions of propagation are considered. The possibility of plasma instabilities is examined in the weak coupling approximation. Consequently those parts of the dispersion curves corresponding to electron waves are redrawn with Doppler shifted frequencies corresponding to an electron drift velocity. The intersections of these curves with the unshifted parts indicate possible wave instabilities. Author (TAB)

N66-36217# General Electric Co., Philadelphia, Pa.
AN ANALYTICAL STUDY OF THE PHYSICAL PROCESSES IN THE CATHODE REGION OF AN ARC Final Technical Report, Feb. 1962–Jun. 1965
T. H. Lee, Allan Greenwood, W. D. Breingan, and H. P. Fullerton Wright-Patterson AFB, Ohio, ARL, Apr. 1966 127 p refs (Contract AF 33(657)-8206)
(ARL-66-0065; AD-636160) CFSTI: HC $4.00/MF $0.75

The objective of the work was to study the fundamental operating processes in the cathode region of an electric arc. The study was primarily theoretical, supplemented with some experimental observations, particularly for arcs in a flow field. A model for the arc between the cathode and the plasma proper was formulated. The governing equations for the different regions of the model were derived and solved numerically by a digital computer. Boundaries between regions were matched as far as possible, to give a self-consistent solution. The solutions obtained indicate that using the model, it is possible to explain electron emission, cathode drop, energy balance, ion current flow and ionization in the transition region for an arc on a refractory cathode in an argon gas. It was thought important to see how the cathode region joins to the contracted portion of the plasma. The energy balance in the contracted region was also studied by treating it as a multicomponent gas with the possibility of its not being in thermal equilibrium. The solution for this region indicates that when flow is an important factor in the energy balance at the arc boundary, there could be a considerable difference between the electron and ion temperatures at the arc boundary. It is believed that this effect must be considered in any study in the entrance region of arc plasma heaters. Author (TAB)

N66-36271# New York Univ., N. Y. Magneto-Fluid Dynamics Div.
THE GUIDING CENTER PLASMA
Harold Grad 15 Mar. 1966 159 p refs Presented at the Am. Math. Soc. Symp. on Magneto-Fluid and Plasma Dyn., New York, 14 Apr. 1965 Submitted for Publication
(Contract AT(30-1)-1480)
(NYO-1480-50; MF-48; CONF-650440-4) CFSTI: HC $5.00/MF $1.00

A survey is given of the theory of equilibrium, motion, and stability of a plasma in the guiding center limit. Author (NSA)

N66-36272# New York Univ., N. Y. Magneto-Fluid Dynamics Div.
MAGNETOHYDRODYNAMIC SHOCK RELATIONS IN NONALIGNED FLOWS
Y. M. Lynn 1 Sep. 1965 101 p refs
(Contract AT(30-1)-1480)
(NYO-1480-29; MF-47) CFSTI: HC $4.00/MF $0.75

The transition solution across a plane magnetohydrodynamic shock of finite strength in nonaligned flows in a perfect gas is investigated. A unified point of view is taken to analyze shocks in both unsteady one-dimensional flows and steady two-dimensional flows. Sets of conversion formulas connecting pertinent parameters in these two cases are given. A convenient parametric representation is presented of the shock solution from which an analytical solution expressed in terms of any desirable shock strength parameter can be readily obtained by performing a straightforward calculation. Major emphasis is then placed on the analytical and numerical solutions in terms of the flow deflection angle across the shock, the parameter most often prescribed in steady two-dimensional flows; entire ranges of upstream parameters are covered. Limiting solutions for several special cases are derived. Analytical solutions in terms of the magnetic field deflection angle across the shock are also given. The connection of the present general solution with several other major results in the literature is shown. Dynamical stability criteria associated with general magnetohydrodynamic shocks are discussed. Author (NSA)

N66-36351# Eidgenossische Technische Hochschule, Zurich (Switzerland).
MEASUREMENTS OF THE SPONTANEOUS OSCILLATIONS OF THE INFRARED RAYS OF A HIGH PRESSURE HIGH CURRENT ARGON DISCHARGE [MESSUNGEN DER SPONTANEN SCHWANKUNGEN DER INFRAROTEN STRAHLUNG EINER HOCHDRUCK-HOCHSTROM-ARGONENTLADUNG]
Werner Gubler (Ph.D. Thesis) 1965 113 p refs In GERMAN
(Rept.-3678) CFSTI: HC $4.00/MF $0.75

The equations describing the spontaneous fluctuations of photon radiation are given by the Bose-Einstein-statistics. These equations are applied to calculate the statistical fluctuations of photon radiation emitted by a nonhomogeneous plasma. By using a photodetector, the radiation fluctuations are transformed into corresponding output current fluctuations. The detector must have special properties as to sensitivity, noise, frequency response and transmission characteristics. The InSb-photodetector described here, has the required properties. As a radiation source, the plasma of a stationary argon arc discharge at high pressure was used. By measuring and calculating the continuous photon radiation, it was possible to determine the temperature distributions in the plasma. Investigations of the electrical conductivity confirms the temperature distributions. Due to the high temperatures as well as the sufficient optical thickness in the infrared spectral range, determination of the fluctuation factors is made possible. Considering the experimental difficulties, the agreement between measured and calculated factors is good. Instabilities in the plasma have been considered and eliminated in the experimental procedure. Author

N66-36398# Naval Ordnance Lab., White Oak, Md.
NONEQUILIBRIUM EFFECTS ON ENERGY TRANSFER IN AN IONIZED FLUID FLOW Final Report
John O. Powers 11 Apr. 1966 131 p refs
(NOLTR-66-59; Aerodynamics Res. Rept.-260; AD-634787) CFSTI: HC $4.00/MF $1.00

A multi-fluid theory is formulated and the resulting equation system is developed and then applied to an ionized fluid flow situation in order to evaluate the mechanisms of energy transfer. The effects of temperature and compositional nonequilibrium were explored for several temperature levels and for a range of fluid flow velocities. Comparisons of the multi-fluid theory results are made with results from conventional single-fluid theory for approximately equivalent fluid flow conditions. The multi-fluid theory investigations produced results which were generally consistent with the single-fluid theory procedures. The multi-fluid results were useful in evaluating the relative importance of the several different energy transfer mechanisms. In particular, it was demonstrated that conditions which yield electron temperatures greater than the heavy particle temperature led to a reduction in total heat transfer with increased electron temperature. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-35462# Franklin Inst., Philadelphia, Pa. Research Labs.
PARAMAGNETIC IMPURITIES IN IONIC CRYSTALS
Final Scientific Report, Period Ending 25 Jan. 1966
A. Neaves, C. Lin, and G. S. Tint Wright-Patterson AFB, Ohio, ARL, Feb. 1966 163 p refs
(Contract AF 33(659)-10068)
(F-B2042; ARL-66-0031; AD-634906) CFSTI: HC $5.00/MF $1.00

The report deals primarily with the results obtained on the systems LiF:Mn^{2+} and Y_2C_3. The theoretical aspects of S-state transition metal ions in host-crystals is dealt with and applied to Mn^{2+} in lithium fluoride. It is found that the method of molecular orbitals used to consider problems of limited covalency is not valid throughout the whole range of $Mn^{2+}F$ bond distances. The possible role of ferromagnetic impurities in yttria and their relation to thermoluminescence in that materials is discussed. A point charge calculation of the crystalline electric field acting on F_e^{3+} situated on the 8B site in yttria is detailed. The systems Al_2O_3, NaCl:Cu^{2+} and NH_4Cl:Mn^{2+} are discussed briefly. Author (TAB)

N66-35481# Arizona State Univ., Tempe. Dept. of Chemistry.
PROTON CONDUCTIVITY IN PURE AND DOPED KH_2PO_4
M. O'Keeffe and C. T. Perrino 1 Jun. 1966 22 p refs
(Contract Nonr-2794(04))
(TR-3; AD-635470) CFSTI: HC $1.00/MF $0.50

The electrical conductivity of pure and KH_5O_4-doped-KH_2PO_4 was measured over a wide range of temperatures under the equilibrium water vapor pressure. For pure KH_2PO_4, the conductivity perpendicular to the C axis is given by $\log \sigma = -1.17 - 2760/T$, $T < 180°C$; $\log \sigma = 2.0 - 3900/T$, $T > 180°C$. The conductivity of doped crystals is 1.06×10^6 C ohm^{-1}cm^{-1}, where C is the mole fraction of sulphate. The results are discussed in terms of the defects possible in KH_2PO_4. Author (TAB)

N66-35538# General Electric Co., Schenectady, N. Y. Research and Development Center.
NEW SOLID-STATE DEVICE CONCEPTS Scientific Report No. 5
M. Aven, R. N. Hall, J. R. Richardson, and H. H. Woodbury Jul. 1966 30 p refs *Its* Rept.-66-GC-0331
(Contract AF 19(628)-4976)
(AFCRL-66-350; AD-635400) CFSTI: HC $2.00/MF $0.50

Experiments on the diffusion of SE in ZnSe were made. This and earlier work indicate that in all the II-IV compounds the chalcogenide component diffuses by a mechanism other than simple vacancy diffusion. This result is of fundamental importance to an understanding of the defect structure of these materials. The electrical properties of the different components of $ZnSe_x Te_{(1-x)}$ light emitting diodes at 80K have been investigated. The current-voltage characteristic of the junction region agrees with classical junction theory. Under self-illumination, the currents carried by the n and p-type bulk regions were ohmic. The major current-limiting factor is the electrical contact to the p-type side of the junction. A mask changer and evaporation rate monitor are being assembled in order to improve the reproducibility of the GaAs switching diodes. Resistivity measurements of evaporated GaAs films yielded values in the 100,000 ohm-cm range at 300°K. No hall mobility has yet been detected. Author (TAB)

N66-35560# California Univ., Los Angeles.
AMPLITUDE DEPENDENT ULTRASONIC ATTENUATION IN SUPERCONDUCTING LEAD
Bernhard R. Michel Tittmann (Ph.D. Thesis) Ann Arbor, Mich., Univ. Microfilms, Inc., 1965 308 p refs

An anomaly in the absorption of ultrasonic waves was found and investigated in superconducting lead. This anomaly consisted of a strong dependence of the absorption on the amplitude of the ultrasonic waves. The amplitude dependence was only weakly present in the normal state. The effect was found to be strongly temperature dependent, decreasing as impurities are added to the crystal and exhibiting little or no change with frequency. Deformation and annealing had a pronounced effect on the anomaly. A model is proposed based on the assumption of a strong interaction between the conduction electrons and the dislocations in the metal crystal. The presence of weakly pinned dislocations and their motion in the field of the sound wave was assumed. In the normal state, this motion is highly damped by the conduction electrons, and therefore, the dislocations cannot contribute much to the ultrasonic absorption. In the superconducting region, this damping decreases with the same temperature dependence as the ultrasonic absorption by the electrons. The dislocations become free to move and therefore can cause an-amplitude dependent-absorption by themselves. Author

N66-35620# New York Univ., N. Y. Radiation and Solid State Lab.
PHOTOGENERATION OF CHARGE CARRIERS IN TETRACENE
Nicholas Geacintov, Martin Pope, and Harmut Kallman 1966 39 p refs Sponsored by NIH and ONR
(AD-634905) CFSTI: HC $2.00/MF $0.50

The photocurrent and photovoltage of tetracene single crystals with aqueous electrodes were studied as a function of the excitation wavelength in the 220-560 millimicron region. The fluorescence efficiency of these crystals was studied in the same wavelength region. At wavelengths longer than 410 millimicron the photocurrent is due to injection of holes at the illuminated electrode. A bulk generated (electron) photocurrent is shown to be produced with excitation energies in excess of 3 eV, i.e. at wavelengths less than 410 millimicrons. The relative fluorescence efficiency begins to decrease with decreasing wavelengths at 410 millimicrons. The drop in fluorescence efficiency at excitation energies greater than 3 eV is attributed to the appearance of a non-radiative competitive process. The wavelength dependence of the bulk generated negative photocurrent is related to varying probabilities of transition from the different excited electronic states of the crystal to ionized states. The wavelength dependence of the photovoltage is strongly dependent on the negative charge density and exhibits minima in wavelength regions where this density is highest. TAB

N66-35706# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
DIELECTRIC RELAXATIONS IN ADDITIVELY COLORED KCl AND KCl: $BrCl_2$ CRYSTALS
Cesare Bucci Jul. 1966 35 p refs
(Contract Nonr-551(28))
(TR-7; AD-635005) CFSTI: HC $2.00/MF $0.50

The dielectric relaxations of additively colored alkali halides have been investigated by means of ionic thermocurrent (I.T.C.) and optical absorption measurements. In addition to the ITC bands present in non-colored KCL crystals, several new bands were found when F centers were partially converted to other centers such as F', M, N, R, Z, Z 1, Z_2, an Z_3, by F-light irradiation at various temperatures. These additional ITC bands were found to be due to the migration of electrons rather than to the orientation of ionic dipoles. In the particular case of the Z_2 centers, which can be obtained only in crystals containing metallic divalent

impurities, ITC and field-induced dicroism measurements did not provide any evidence for the existence of an electric dipole moment of the Z_2 center itself. Quantitative measurements of the impurity-vacancy dipole (i. v.) concentrations in KCl:$SrCL_2$ crystals indicate, in addition, that the growth of the Z_2 centers is accompanied by a decrease of the i. v. band. The proportionality constant between the number of Z_2 centers created and the number of I. V. dipoles destroyed during the $F \rightarrow Z_2$ conversion was slightly more than three. These results support a model for the Z_2 center having spherical symmetry and suggest that the process of formation of the Z_2 centers is closely related to the association of I. V. dipoles into trimers. Author (TAB)

N66-35727*# Naval Ordnance Test Station, China Lake, Calif.
THE FORMATION OF THIN CONTINUOUS FILMS FROM ISOLATED NUCLEI
H. Poppa (Gen. Dyn./Convair), E. Bauer, A. K. Green, and K. M. Kunz [1965] 41 p refs Presented at a conf.
(NASA Order R-05-030-001)
(NASA-CR-68778) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The rigid model of the film growth is discussed and the results of in-situ investigations are reviewed. The generality of the conclusions drawn from in-situ experiments is examined by a discussion of the influence of the experimental conditions (the effects of the electron beam, the residual gases, the substrate surface conditions, and the film and substrate materials), and by an analysis of the growth of f.c.c. metals on alkali halides. In the final discussion the most striking phenomena observed in the formation of thin continuous films from isolated nuclei are considered from the theoretical point of view. Author

N66-35731*# Delaware Univ., Newark. Dept. of Physics.
X-RAY DAMAGE AND ANNEALING OF THESE DEFECTS IN CdS SINGLE CRYSTALS Technical Report No. 16
K. W. Boer, J. C. O'Connell, and R. Schubert Nov. 1965 13 p refs Submitted for Publication
(Grant NsG-573)
(NASA-CR-68250) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The influence of X-ray damage at 250 keV and 300 keV in ultrahigh vacuo on the spectral distribution of photoconductivity and conductivity glow curves is described. The observed damage can be explained by assuming a production of sulfur vacancies by X-rays and a later diffusion determined formation of associates of these vacancies with acceptors resulting in recombination centers. The threshold energy for sulfur vacancy formation lies at about 250 keV. Author

N66-35815# Los Alamos Scientific Lab., N. Mex.
LOS ALAMOS STRAIGHT LINE DIAGRAM FOR POWDER PATTERN INDEXING
James S. Coleman and B. B. Mc Inteer 20 May 1966 51 p ref
(Contract W-7405-ENG-36)
(LA-3467) CFSTI: HC $3.00/MF $0.50

A new graphical method is described which is useful for indexing X-ray powder patterns. The experimental points with various Miller indices are plotted so that the points with the desired indices fall on straight lines. Application is illustrated for all crystal symmetries. Related graphical methods are discussed in the appendixes. Author (NSA)

N66-35819# General Instrument Corp., Newark, N. J. Thermoelectric Div.
THERMOELECTRIC BISMUTH TELLURIDE IMPROVEMENT PROGRAM Final Report
[1966] 74 p
(Contract AT(30-1)-3362)
(GIC-3362-4) CFSTI: HC $3.00/MF $0.75

A survey of the bismuth telluride alloys, involving changes in the bismuth antimony ratio, additions of various dopants to increase the power number at elevated temperatures was made. The Figure of Merit was also measured by measuring the thermal conductivity on those alloys which were optimized (as shown by the power number) in an attempt to correlate the power number with the Figure of Merit. Various additions were then made in order to increase the energy gap and change the temperature coefficient so that thermoelectric property will have a net gain in the Figure of Merit. NSA

N66-35827# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY OF THE IRREVERSIBLE MAGNETIC BEHAVIOR OF SUPERCONDUCTORS [CONTRIBUTION A L'ETUDE DU COMPORTEMENT MAGNETIQUE IRREVERSIBLE DES SUPRACONDUCTEURS]
Gérard Kuhn (Ph.D. Thesis—Grenoble Univ.) 1966 116 p refs In FRENCH
(CEA-R-2808)

The influence of the presence of extended lattice defects on the magnetic behavior was studied for the case of type I superconductors, such as Re and Ta, and in a more quantitative manner for the type II superconductor niobium. In this case, measurements of the thermal conductivity have given an estimate of the relative concentration of lattice defects in each specimen. These measurements show that the larger the number of lattice defects, the more irreversible becomes the magnetization curve, and the larger becomes the values of the critical current, which is related by a simple model to the magnetization values. Finally, a study by transmission electron microscopy has confirmed on the one hand the diversity of the extended lattice defects and on the other hand has allowed the formulation of several hypothesis on their respective influence. Author (NSA)

N66-35843# Oak Ridge National Lab., Tenn.
ORGNU: A FORTRAN PROGRAM FOR CALCULATING FREQUENCY-DISTRIBUTION FUNCTIONS OF CUBIC CRYSTALS
L. J. Raubenheimer and G. Gilat Jun. 1966 41 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1425) CFSTI: HC $2.00/MF $0.50

A computer program is described which finds the frequency-distribution function of a centrosymmetric cubic solid for which a Born-von-Karman force model is available. The FORTRAN language is used in order to facilitate modifications necessary for other force models, as well as other crystal structures. Detailed instructions for using the program are included. Author (NSA)

N66-36138*# National Aeronautics and Space Administration, Washington D. C.
OHMIC TRANSPORT CONTACT FOR A^2B^6-TYPE PHOTOCONDUCTORS [DO PITANNYA PRO OMICHNIY PROZORIY KONTAKT DO FOTOPROVIDNIKIV TIPU A^2B^6]
S. V. Svechnikov, Yu. O. Tkhorik, and Yu. G. Pys'menniy Sep. 1966 13 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 1, 1966 p 40–44
(NASA-TT-F-10272) CFSTI: HC $1.00/MF $0.50 CSCL 20L

An experimental investigation of the applicability of CdO films as transparent ohmic contacts with CdS (single-crystal and film type) photoconductors is reported. The determined optical and electrical properties of both CdO films and CdO–CdS contacts indicate that this type of contact should be well suited for use in photoelectric devices, particularly in the case of longitudinal photoconductivity. The CdO films investigated

exhibited low resistivity and temperature dependence over a wide temperature range, combined with a high transmission coefficient and a linear current-voltage characteristic. Author

N66-36137*# National Aeronautics and Space Administration, Washington, D. C.
PREPARATION OF CdS SINGLE CRYSTALS AND THEIR STRUCTURAL AND ELECTROPHYSICAL PROPERTIES [VIGOTOVLENNYA, STRUKTURNI TA ELEKTROFIZICHNI VLASTIVOSTI CdS-MONOKRISTALIV]
I. D. Konozenko, E. O. Muzalev'kii, A. I. Rovna, O. P. Galushka, G. G. Shmatko et al Sep. 1966 16 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 2, 1966 p 171–176
(NASA-TT-F-10277) CFSTI: HC $1.00/MF $0.50 CSCL 20L

A procedure for growing granular CdS single crystals by the zone sublimation method is described. An x-ray analysis of structural defects demonstrates the superiority of the crystals over those obtained by the recrystallization method. The photosensitivity curves obtained for the crystals exhibit a broad maximum. The depth of levels and the concentration of capture levels are determined. Author

N66-36206# Cornell Univ., Ithaca, N. Y.
OPTICAL STUDY OF EXCITONS IN MIXED ALKALI HALIDES: KI-KBr
Hung Kuen Alan Kan (Ph.D. Thesis) Feb. 1966 100 p refs Sponsored by ARPA and ONR
(AD-634820) CFSTI: HC $3.00/MF $0.75

The absorption and luminescence properties of KI-KBr mixed crystals were studied over a wide range of KI concentrations. In all systems an absorption band was found which was attributed to a localized exciton formed at an I^--site. The position of the band shifts toward the first exciton absorption peak of pure KI with increasing I^- concentration. For dilute I^--concentrations the width of the band is twice as large as the width of pure KI or the 82 mole% KI sample. It was also found that the low photon energy absorption edge of this band was an exponential function of photon energy (Urbach's rule) in all mixtures. All the KI-KBr mixed crystals showed a strong luminescence at 80° K when excited in the exciton absorption band. In all cases two emission bands were observed. The existence of Urbach's rule and occurrence of two emission bands in these mixed-halide crystals is compared with the similar behavior of pure alkali halides. Author (TAB)

N66-36258# Eidgenossisches Technische Hochschule, Zurich (Switzerland).
INVESTIGATION IN THE APPEARANCE OF A BREACH IN SEMICONDUCTOR ATTENUATION LAYERS AND ITS APPLICATION, PARTICULARLY OF TUNNEL-DIODES [UNTERSUCHUNGEN UEBER DURCHBRUCHERSCHEINUNGEN IN HALBLEITERSPERRSCHICHTEN UND DEREN ANWENDUNGEN, INSBESONDERE VON TUNNELDIODEN]
Hans Melchior (Ph.D. Thesis) 1965 279 p refs *In* GERMAN
(Rept.-3661) CFSTI: HC $6.00/MF $1.50

Electrical breakdown phenomena in semiconducting diode junctions were analyzed for their physical background and results are presented in tables. Evaluated were noise level frequencies at primary diode breakdown, distortion effects, mixing processes, and oscillating amplitudes of the tunnel diode junctions. Also included were analog gas discharge frequency variations that showed similarity with semiconductor junction and transistor breakdown effects. Transl. by G.G.

N66-36265*# George Washington Univ., Washington, D. C.
ORGANIC SYSTEMS INVOLVING TRANSITION METALS FOR OPTICAL LASER MATERIALS Semiannual Research Report, 1 Nov. 1965–30 Jun. 1966
N. Filipescu 10 Aug. 1966 7 p refs
(Grant NsG-603)
(NASA-CR-77913) CFSTI: HC $1.00/MF $0.50 CSCL 20L

A large number of organic solvent sensitizers and rare earths were evaluated for their maximum fluorescence conditions and the lanthanide ions Eu^{3+}, Tb^{3+}, Sm^{3+}, and Dy^{3+} evolved as most suitable for sensitization. Quantitative factors studied on the overall energy transfer efficiency were: viscosity, oxygen concentration, excitation wavelengths, and photokinetics. A number of new chromophore-generating compounds and rigid frames were developed for the synthesis of molecular configurations, and a photochemical apparatus was constructed for future evaluation of chemical changes in laser materials. Results on quantum efficiency measurements of europium chelates and europium β-diketonates were published elsewhere. G.G.

N66-36419# Boeing Scientific Research Labs., Seattle, Wash.
PLASMA PHYSICS LABORATORY REVIEW, JANUARY–JUNE 1966
James E. Drummond et al [1966] 30 p refs

Details are given on the use of a two-component laser interferometer to measure the strain rate at the Kern River fault. With this instrument, velocity gradients in the earth were measured on a daily basis with 10^4 times greater sensitivity than possible before. Other continuing research in various phases of plasma physics is summarized. Topics pursued in plasmas in solids include fundamental property measurements, microwave radiation, pinch effect, and plasma density probe. Also discussed are plasma diffusion studies, oscillation theory for plasma in semiconductors, laser production of plasmas, onset of turbulence in the positive column, Alfven waves in relativistic waves, plasma radiation from silver foils, diffusion of a magnetically pumped plasma, and high frequency field penetration. L.E.W.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-35631# California Univ., Berkeley. Thermal Systems Div.
PERFORMANCE OF ANHYDROUS AMMONIA AS A SPARK IGNITION ENGINE FUEL Technical Report No. 6
D. S. Smith and E. S. Starkman Feb. 1966 63 p refs
(Contract DA-04-200-AMC-791(X))
(TS-66-2; AD-633632) CFSTI: HC $3.00/MF $0.75

Ammonia can be used successfully as a spark ignition engine fuel and at presently existing compression ratios, if introduced as a vapor and if first partly dissociated to hydrogen and nitrogen. Under such circumstances little engine modification is necessary other than a means for flow control of the ammonia and adjustment of the spark timing. Maximum experimental power output for ammonia was 72 per cent of that for iso-octane. This result compares favorably with a theoretically predicted output, when adjusted for 5 per cent hydrogen dissociation, of 75 per cent. specific fuel consumption using ammonia is increased by a factor of 2 over that of hydrocarbon when compared at peak power and 2-1/2 times when compared at maximum economy. Hydrogen concentration in the fuel feed is a critical factor for successful operation on ammonia as fuel, minimum concentrations appear to be 4 to 5 per cent by weight at intermediate engine speeds of 1800 rpm, engine performance rapidly falls if less than minimum

concentrations of hydrogen are used. This seems to relate to the self-generating character of the ammonia decomposition during the compression and combustion processes. Performance factors such as are influenced by engine speed, spark timing and manifold pressure are not far different with ammonia than with hydrocarbons as long as minimum amounts of hydrogen are inducted as a part of the fuel flow. Author (TAB)

N66-35933*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VACUUM EFFECTS ON SOLID-PROPELLANT ROCKET FUEL
John P. Mugler and James M. Bradford *In* NASA. Lewis Res. Center High-Vacuum Technol., Testing, and Meas. Meeting Aug. 1966 p 193–196 (See N66-35906 21-11) CFSTI: HC $6.00/MF $1.50

Measurements of outgassing rates for polyurethane and PBAA fuels are presented as part of a program to study effects of vacuum on solid propellant rocket fuel. The rate of pressure rise technique was used to measure outgassing rates as a function of vacuum exposure time. Outgassed products of both polyurethane and PBAA were identified by a time-of-flight mass spectrometer installed in the chamber. A mass spectrogram of polyurethane after 160 hours in vacuum shows water as the main outgassing product; however the spectrum for PBAA after 180 hours shows hydrocarbons as the main constituents. S.P.

N66-35960*# United Aircraft Corp., East Hartford, Conn. Research Labs.
ANALYTICAL STUDY OF CATALYTIC REACTORS FOR HYDRAZINE DECOMPOSITION Quarterly Progress Report No. 1, 15 Apr.–14 Jul. 1966
A. S. Kesten Jul. 1966 20 p refs
(NASA-CR-77763; E910461-3) CFSTI: HC $1.00/MF $0.20 CSCL 21I

Work is reported in the preparation of equations comprising the steady-state microscopic model of a distributed-feed catalytic reaction chamber in a form amenable to numerical solution. An iterative procedure was developed to solve the implicit integral equations describing reactant concentration and temperature profiles in the porous catalyst particles. Numerical methods were developed for the simultaneous solution of these equations with the equations describing the variation of reactant concentrations and temperature with axial position in the interstitial phase. A computer program utilizing these procedures is being written. Reduction of the equations comprising the transient macroscopic model to a form amenable to numerical solution was initiated. Overall transport coefficients were used to define the driving forces for heat and mass transfer in terms of the temperature and concentration difference between the interstitial phase and the gas phase in the interior of the catalyst particles. Author

N66-36013# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
MIXING SYSTEM FOR FUEL GELLING Final Report
Herbert I. Hoffman 25 Feb. 1966 16 p refs

The rapid multi-port injection of fluids was studied to demonstrate that rapid distribution of gelling agents in a fuel tank was possible without extensive valve arrangements. The objective was to achieve satisfactory chemical injection and rapid fuel gelling with a safe gas energized injector having a minimum number of moving parts. Results of preliminary injection tests conducted with water illustrating the main parameters of burst pressure, liner thickness, and percentage of holes perforated are shown. Although the goals of this project were not achieved because of the difficulties in developing suitable chemical resistant, brittle liners for pre-perforated injection tubes, it is noted that a multiorifice injector tube of the type studied can be practical for one-shot injection of liquids or gases where minimum elapsed time requires a prefilled tube. A.G.O.

N66-36216# Stanford Research Inst., Menlo Park, Calif. Polymer and Propulsion Sciences.
RESPONSE OF A BURNING PROPELLANT SURFACE TO EROSIVE TRANSIENTS Quarterly Report No. 1, 1 Jan.–31 Mar. 1966
E. L. Capener, Lionel A. Dickinson, and G. A. Marxman 22 Apr. 1966 24 p refs
(Contract AF 49(638)-1665)
(AFOSR-66-0938; AD-634296) CFSTI: HC $1.00/MF $0.50

It was previously found that the heat release in the solid phase was associated with the driving process of unstable combustion. Since most of the propellants of interest are based on ammonium perchlorate (which has been shown to endow propellants with instability), it was considered necessary to identify the processes which could attenuate acoustic waves. A study of loss mechanism demonstrated that end losses are significant and enhance both axial and transverse stability. In the case of axial instability the enhanced heat transfer to the end closure was examined using heat transfer gauges. Theoretical studies are continuing in an attempt to integrate combustion response to the gas dynamics of the cavity. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-35582# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TWO-DIMENSIONAL JET MIXING IN A SUPERSONIC FLOW
Donald E. Johnson (M.S. Thesis) Apr. 1966 80 p refs
(GAM/ME/66B-12; AD-635255) CFSTI: HC $4.00/MF $0.75

The two-dimensional turbulent mixing region, resulting when a near sonic helium jet impinges at 30, 45 or 60° on a supersonic air stream, was experimentally investigated utilizing an interferometer, a gas analyzer, and a total pressure rake. This type of mixing has a possible application in the supersonic combustion ramjet engine. Volumetric concentration profiles and a total pressure map of the mixing region were obtained for each injection angle. The mixing obtained for each injection angle was compared with that obtained with other injection systems. The techniques used for spark lamp photography are discussed. It was concluded that the interferometer cannot be focused so that fringes can be obtained throughout the mixing region at one interferometer setting. Many photographs at different interferometer settings would be required to determine the density distribution in the mixing region for gases having an extreme density difference. Author (TAB)

N66-35709# California Univ., Berkeley. Thermal Systems Div.
CALCULATION OF ENGINE PERFORMANCE USING AMMONIA FUEL. III: BRAYTON CYCLE
Henry K. Newhall Dec. 1965 80 p refs *Its* Tech. Rept.-4
(Contract DA-04-200-AMC-791(X))
(TS-65-6; AD-633633) CFSTI: HC $3.00/MF $0.75

The performance of ammonia as a fuel for gas turbine application was theoretically predicted. Regenerative and non-regenerative Brayton cycles were employed as theoretical models, and combustion products were treated as a chemical equilibrium reactive system. All calculations were carried out by programs developed for use on an IBM 7094 digital computer. The following conclusions are based upon the theoretically predicted results: (1) ammonia can yield power output up to 10% greater than that for hydrocarbon

fuels operating under the same conditions of limited turbine inlet temperature, (2) thermal efficiencies for ammonia should range up to 10% higher than those for hydrocarbon fuels, (3) specific fuel consumption for ammonia is predicted to exceed by 2-1/2 to 3 times that for hydrocarbon fuels. Author (TAB)

N66-35798*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

STUDY OF LOW ACCELERATION SPACE TRANSPORTATION SYSTEMS. VOLUME I: SUMMARY Phase II Study Report

G. L. Coates and Harold Brown 15 Jul. 1966 45 p *Its* Doc.-66SD2026

(Contract NASA8-11423)

(NASA-CR-77857) CFSTI: HC $2.00/MF $0.50 CSCL 21F

The technical feasibility of using nuclear electric propulsion assisted by nuclear rocket propulsion for a manned Mars mission was evaluated. Solar-electric vehicles were also considered. The techniques used in analyzing the mission are summarized. The nominal mission module, featuring a combined command and control center and solar flare shelter surrounded by living quarters, work area, and recreation facilities, is described. The three types of propulsion systems (main electric propulsion, nuclear rocket for earth departure, and high thrust for Mars departure units) are discussed. The initial results of a reliability study to identify critical components, a reasonable set of preliminary component reliability objectives, a plausible overall reliability strategy, and a first cut at the system performance penalties associated with establishing a man-rated level of reliability are presented. The solar-electric vehicle design is described. The effects of major system design parameters and several operational options on the overall system performance characteristics are examined. The hybrid nuclear rocket–nuclear electric vehicle performance characteristics are compared with those of conventional high thrust chemical and nuclear rocket propulsion systems. R.N.A.

N66-35955*# National Aeronautics and Space Administration, Washington, D. C.

STATE OF DEVELOPMENT OF THE GIESSEN ION ENGINE [ENTWICKLUNGSSTAND DES GIESSENER IONENTRIEBWERKES]

H. Loeb Aug. 1966 25 p refs Transl. into ENGLISH of a paper presented at the Symp. on Elec. Space Motion, Sonnenberg, West Germany, 24 Feb. 1966 p 1–13

(NASA-TT-F-10250) CFSTI: HC $1.00/MF $0.50 CSCL 21C

Results are presented of a study to improve the absolute and specific power outputs of an electrostatic test engine. The results cited mainly concern the ionizer, since this is said to be the part of the engine which differs most from American models. The ionizer in this case is a high-frequency ion source distinguished by the fact that it allows mercury to be used as the propellant, creates only singly charged ions, is simple to build, and is lightweight and long-lasting. It is shown that such a high-frequency ion source can be developed by increasing the discharge intensity with the aid of a weak, constant magnetic field, and by improving the process of ion extraction. Author

N66-35957*# National Aeronautics and Space Administration, Washington, D. C.

PROSPECTS OF PISTON AND TURBOJET ENGINES FOR LIGHT AIRCRAFT [ZUKUNFTSAUSSICHTEN DER KOLBENMOTOREN UND TURBOTRIEBWERKE FUER LEICHTFLUGZEUGE]

L. v. Bonin and K. Grasmann Aug. 1966 64 p refs Transl. into ENGLISH of paper presented at the 6th European Aeron. Congr., Munich, 1–4 Sep. 1965

(NASA-TT-F-10252) CFSTI: HC $2.50/MF $0.75 CSCL 21E

Analysis showing that a turbojet engine developed on the basis of a supercharging engine with very high bypass ratio should be superior to the piston and turbojet engines currently used in light aircraft. A discussion of the layout and rating of such an engine leads to a bypass configuration with a bypass ratio of roughly 6, capable of crusing at speeds between 500 and 550 km/hr with a payload comparable to that of equivalent piston engine aircraft. Author

N66-36091*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

ARCJET TECHNOLOGY RESEARCH AND DEVELOPMENT Second Quarterly Progress Report, 1 Sep.–30 Nov. 1964 27 Dec. 1964 60 p refs

(Contract NAS3-5900)

(NASA-CR-57452; RAD-SR-65-5) CFSTI: HC $3.00/MF $0.75 CSCL 21C

Explored were increases in specific impulse and efficiency which appear to be associated with operation at lower propellant mass flow rates with and without external magnetic fields. Propulsion performance data were obtained with hydrogen and ammonia as propellants over a wide range of propellant flow rates, arc currents, arc powers, and applied magnetic field strengths. Overall efficiency values (at input power levels of 20 to 160 kW) for hydrogen were 25% at 3000 seconds, 30% at 4000 seconds, and 40% at 5000 seconds; for ammonia (at input power levels of 20 to 80 kW), 30% at 3000 seconds, and 35% at 3500 seconds. Data were also obtained with helium, argon, and nitrogen as propellants. An effort was also made to separate the contributions to the experimentally measured thrusts from the different thrust-producing mechanisms. R.R.D.

N66-36150# Eidgenossische Technische Hochschule, Zurich (Switzerland).

INVESTIGATION OF THE FLOW OVER A DISCONTINUITY IN CONNECTION WITH INJECTION LOSSES IN STEAM AND GAS TURBINES [UNTERSUCHUNG DER STROEMUNG UEBER EINEN ABSATZ IM ZUSAMMENHANG MIT DEN INJEKTIONSVERLUSTEN BEI DAMPF- UND GASTURBINEN]

Ulrich La Roche (Ph.D. Thesis) 1965 221 p refs In GERMAN; ENGLISH summary

(Rept.-3575) CFSTI: HC $4.00/MF $1.00

The injection losses in steam and gasturbines are investigated on the basis of the principal flow phenomena that cause them. These losses are connected with the discontinuity of the sidewalls in the annular flow channel between stator and rotor blade rows. Theoretical and experimental results on the flow parameters and the boundary layer with arbitrary injection rates at the two-dimensional discontinuity for subsonic velocities are given. Results include: a theory of the flow over a discontinuity using conformal mapping technique and boundary layer calculation of a free jet boundary, experimental confirmation of theory and measurement of influence of flow parameters at discontinuity on boundary layer parameters. The dissipation values are compared to an universal dissipation function for two-dimensional boundary layers which is calculated and presented. The second part gives the measurements made with an impulse type turbine stage, which show, that the results of the first part apply to the actual condtions within a turbine. The third part includes discussion of some special problems and a completely self-contained calculation procedure for application of the results to steam and gasturbine design. Author

N66-36208# Army Foreign Science and Technology Center, Washington, D. C.

PATHS OF DEVELOPMENT OF STATIONARY GAS TURBINE ENGINES IN USSR. USE OF PETROLEUM FUEL AND DISSOLVED ADDITIVES FOR LOWERING VANADIUM CORROSION IN GAS TURBINE ENGINES

G. I. Shuvalov, G. G. Ol'khovskiy, R. A. Lipshteyn Jun. 1966 22 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 9, 1964 p 2–6, 19–21
(FSTC-HT-23-122-66; TT-66-61589; AD-634815) CFSTI: HC $1.00/MF $0.50

The first article surveys the results of experimental development of Soviet gas turbine engines and ways of using them in power engineering. Detailed tables are given showing characteristics of various engines. The second article considers the question of choice of additives to sulfurous petroleum fuel permitting the avoidance of appreciable vanadium corrosion during the operation of the gas turbine engines. Author (TAB)

N66-36416*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY EVALUATION OF FLIGHT-WEIGHT XRJ47-W-5 RAM-JET ENGINE AT A MACH NUMBER OF 2.75
Henry J. Welna and Dwight H. Reilly Washington, NACA [1955] 43 p refs
(NACA-RM-E66G22) CFSTI: HC $2.00/MF $0.50 CSCL 21E (Declassified)

Afree jet investigation of the performance, burner-shell cooling, liner durability, and ignition characteristics of a flight-weight, 48-in. diameter ramjet engine was conducted in an altitude test chamber at an inlet Mach number of 2.75 and an angle of attack of 3°. A combustion efficiency of 0.85 was obtained at an air flow of 60 lb/sec, inlet temperature of 990°R, and the approximate design fuel-air ratio of 0.043. The combustor total-pressure ratio at this condition was 0.80. At an inlet temperature of 990°R, flight-engine lean blowout occurred between a fuel-air ratio of 0.027 to 0.028 for the altitude range investigated. Three cooling-liner configurations were examined, whose principal differences were in the type of liner corrugations and the method of securing the liner in the combustor. Three different ignition sources were also evaluated: one consisted of flares attached to the flameholder and the other two were based on injection of small quantities of boron triethyl and aluminum trimethyl into the combustor in the region of the flameholder. Numerous photographs, tables, and graphs are included to illustrate procedure, apparatus, and results. L.E.W.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-35386# India. Dept. of Atomic Energy, Bombay Cosmic Ray Committee.
PROCEEDINGS OF THE NINTH SYMPOSIUM ON COSMIC RAYS, ELEMENTARY PARTICLE PHYSICS AND ASTROPHYSICS
K. A. Neelakantan (Tata Inst. of Fundamental Res.) [1966] 865 p refs Symp. held in Bombay, 13–17 Dec. 1965 CFSTI: HC $11.65/MF $4.25

Conference papers dealing with cosmic ray propagation and measurement, elementary particle physics, and astrophysics. For individual titles, see N66-35387 to N66-35458. M.W.R.

N66-35387# Physical Research Lab., Ahmedabad (India).
STATUS REPORT ON IQSY AND SOME REMARKS ON THE INDIAN PROGRAMME
K. R. Ramanathan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys [1966] p 1–43 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Disciplines represented in research activities, existing observations stations, publications, and future international cooperation are discussed in terms of activities related to the International Quiet Sun Year (IQSY). In a review of the program in India, it is noted that there exists a good observational network for studies in meteorology, geomagnetism, and ionospheric properties. Mention is made of researches and facilities in these areas, including radio tracking of NASA beacon satellites, high level balloon ascents, optical studies of solar phenomena, ionosonde stations with self-recording equipment, and a new magnetic observatory. M.W.R.

N66-35388# Tata Inst. of Fundamental Research, Bombay (India).
ON THE PRODUCTION OF ELECTRONS IN INTERSTELLAR SPACE
B. Vijayalakshmi *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 44–53 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Attention is given to the calculation of the secondary electron spectrum which arises from the decay of the pions produced in collisions of primary cosmic ray nuclei with interstellar matter; and the energy spectrum of electrons can be obtained by solving a diffusion equation. The spectra obtained are representative of the galactic spectra which are subject to modulation within the solar system. By applying suitable energy losses and solar modulation factors, the energy spectra of electrons and positrons are calculated; and a comparison of these with the electron spectrum observed experimentally results in calculations for electron spectrum at the source. Positron to electron ratio is determined as a function of energy, and it is noted that these calculations are valid as long as there are no free electrons. Since there are free electrons in space, they can scatter act as centers for the scattering of electrons and positrons and, thereby, steepen the spectrum of electrons observable on earth. M.W.R.

N66-35389# Tata Inst. of Fundamental Research, Bombay (India).
THE ELECTRON COMPONENT OF THE PRIMARY COSMIC RADIATION AT ENERGIES ≥15 GeV
R. R. Daniel and S. S. Stephens *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 54–57 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A hypersensitized nuclear emulsion stack was used to study the electron component of the cosmic radiation at energies of 15 GeV and above. As a result of the identification of 12 events, it is concluded that the flux of the primary electrons at the energies studied is 0.68 ± 0.20 per m^2 ster sec; and this is about 20 times greater than that which could arise from collisions of cosmic ray particles in 3 g/cm^2 of interstellar space. The integral energy spectrum in the region from five to 100 GeV is found to have an exponent of approximately 1.16; and there appears to be an excess of positrons over electrons at high energies. M.W.R.

N66-35390# Tata Inst. of Fundamental Research, Bombay (India).
FLUX OF PRIMARY PROTONS AND HELIUM NUCLEI NEAR THE GEOMAGNETIC EQUATOR
P. C. Agrawal, S. V. Damle, G. S. Gokhale, George Joseph, P. K. Kunte et al *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astroophys. [1966] p 58–68 refs (See N66-35386 21-29) CFSTI: $11.65/MF $4.25

Measurements of the vertical intensities of protons and helium nuclei, in flights up to 5 gm/cm^2 depth in the atmosphere over Hyderabad ($\lambda = 8°N$) during April 1965, with telescopes consisting of two scintillator elements and one Cerenkov element are reported. These are compared with similar measurements during the 1957–65 period. There appear to be no solar modulation

effects on the proton and helium components above a vertical cut-off rigidity of ~16 GV. The present measurement gives for the vertical proton flux, as an upper limit, $J_p(0)=130\pm2$ particles/m^2–sec. sterad. Author

N66-35391# Tata Inst. of Fundamental Research, Bombay (India).
ENERGY SPECTRUM OF PRIMARY HELIUM NUCLEI AT ENERGIES > 6 GeV/N
K. C. Anand, R. R. Daniel, B. Bhowmik, C. S. Krishna (Delhi Univ.), P. K. Aditya et al (Indian Inst. of Tech., Delhi) *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 69–76 refs (See N66-36386 21-29) CFSTI: HC $11.65/MF $4.25

A preliminary analysis has been made with 1102 primary helium nuclei recorded in an emulsion stack flown oriented in the east–west plane under 10.2 g/cm^2 of residual atmosphere on April 6, 1963, over Hyderabad, India. The integral energy spectrum of the primary helium nuclei in the energy region between 6 GeV/n and 20 GeV/n has been obtained by making use of the variation of the geomagnetic cut-off rigidity in the east–west plane. It is found that the integral energy spectrum can be represented by a power law with an exponent $\gamma=1.5\pm0.25$. The vertical intensity of the primary helium nuclei is found to be 16.3 ± 0.6 Peters above an effective cutoff energy of 8.47 GeV/n. Author

N66-35392# Tata Inst. of Fundamental Research, Bombay (India).
ISOTOPIC COMPOSITION OF HELIUM NUCLEI IN THE PRIMARY COSMIC RAYS
S. Biswas, P. J. Lavakare, S. Ramadurai, and N. Sreenivasan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on p 77–83 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

An insensitive nuclear emulsion stack was used to determine the isotopic composition of helium nuclei in primary cosmic rays. The stack, exposed at a mean atmospheric depth of 3.0 gm/cm^2 for 11.2 hr, was flipped by 90° on reaching the ceiling and its 10cm side was vertical at ceiling altitude. Based on energy per nucleon, it is concluded that the ratio of He^3/He^3+He^4 indicates that the low energy primary cosmic rays have travelled through about 6 to 8 gm/cm^2 of interstellar matter. If the value obtained for equal rigidity interval is taken, this value could be as high as 9 to 11 gm/cm^2. The energy per nucleon value is considered a better estimate because (1) He^3 nuclei are assumed to be produced in collisions of heavier nuclei with the interstellar hydrogen and (2) in these collisions, the velocity of the primary nucleus is usually maintained by the fragment. Since the ratio of He^3/He^3+He^4 is not found to differ in 1963 and 1965, it is concluded that solar modulation has had no effect. M.W.R.

N66-35393# Tata Inst. of Fundamental Research, Bombay (India).
USE OF GAS CERENKOV COUNTER FOR THE STUDY OF THE ISOTOPIC COMPOSITION OF HELIUM NUCLEI IN THE PRIMARY COSMIC RADIATION
P. C. Agrawal, S. V. Damle, G. S. Gokhale, George Joseph, and M. G. K. Menon *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophy. [1966] p 84–93 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The use of a high pressure gas Cerenkov counter, using sulphur hexafluoride gas as radiator, for the study of the isotopic composition of primary helium nuclei at relativistic energies, is described. Details about ground calibration are presented. Data obtained from two balloon flights at Hyderabad (λ = 8°N) during Apr–May 1964 give $He^3/(He^3+He^4)=0.43\pm0.23$ above a constant rigidity, and $He^3/(He^3+He^4)=0.54\pm0.26$ above a constant energy per nucleon. Author

N66-35394# Tata Inst. of Fundamental Research, Bombay (India).
THE RATIO HE^3 (HE^3+HE^4) IN PRIMARY COSMIC RADIATION AT HIGH RIGIDITIES
M. V. K. Apparao *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 94–97 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Difference in slopes of the energy spectra of helium and M nuclei at the source has previously been considered the cause of the ratio of helium to M nuclei rising from a rigidity of 1.5 BV, falling to a minimum of about 2.5 BV, and rising again toward higher energy. Because of the high value of this ratio, 0.54 ± 0.26, that has been reported, consideration is also given to the presence of He^3 nuclei at high rigidities. The high value of He^3 abundance at rigidities greater than 5 BV is not attributed to spallation of higher mass nuclei, because this makes the amount of matter traversed by cosmic rays too large; and the amount of matter traversed by He and M nuclei is also restricted by the shape of the differential rigidity spectra. It is, therefore, concluded that the excess He^3 is due to He^3 at the source of the cosmic ray beams. M.W.R.

N66-35395# Tata Inst. of Fundamental Research, Bombay (India).
ENERGY SPECTRUM OF ALPHA PARTICLES BELOW 600 MeV/NUCLEON ON 21ST JUNE 1964
K. A. Neelakantan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 98–104 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The differential energy spectrum of helium nuclei of the primary cosmic radiation has been determined in the energy interval 82 to 600 MeV/nucleon. The experiment was done in a stack of emulsions flown from Fort Churchill, Canada (Geomagnetic latitude $\lambda=71°N$) on 21st June 1964 under 2.7 gm/cm^2 of residual atmosphere. The results indicate that the rigidity spectrum obtained in the present experiment is different at rigidities R<1.3 BV from the spectrum measured in 1954 (the previous solar minimum). In the rigidity interval (1.0–1.3) BV, the flux of helium nuclei was 18 ± 4 per m^2.sec.ster. in 1964 compared to a flux of 31 ± 4 per m^2.sec.ster. in 1954. The integral flux of nuclei with $Z\geq3$ and with energies greater than 150 MeV/nucleon is estimated to be (31 ± 6) per m^2.sec.ster. in 1964. Author

N66-35396# Tata Inst. of Fundamental Research, Bombay (India).
THE COMPOSITION AND ENERGY SPECTRUM OF LOW ENERGY HEAVY NUCLEI IN THE PRIMARY COSMIC RAYS DURING JUNE 1963
K. C. Anand, S. Biswas, P. J. Lavakare, S. Ramadurai, and N. Sreenivasan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 105–114 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The heavy nuclei ($Z\geq3$) were studied using a nuclear emulsion stack exposed under 3 g/cm^2 of residual atmosphere from Fort Churchill, Canada, in June 1963. Results on the differential energy spectra of L ($3\leq Z\leq5$), M ($6\leq Z\leq9$) and H ($Z\geq10$) nuclei in the energy interval 150 to 575 MeV/nucleon and on the integral fluxes for nuclei of energy > 575 MeV/nucleon are presented. The L/S (S nuclei $Z\geq6$) ratio at the top of the atmosphere is obtained as 0.36 ± 0.08 for nuclei of energies 150 to 575 and > 575 MeV/nucleon, respectively. These indicate that, when compared with the result of L/S ratio of 0.18 ± 0.04 for nuclei of energy ≥1.5 BeV/nucleon, this ratio is higher in the low energy region and hence the amount of interstellar matter traversed by low energy particles is probably larger. Satisfactory charge resolution is obtained for nuclei Z=3 to 12. Author

N66-35397# Punjab Univ., Chandigarh (India). Dept. of Physics.
A STUDY OF HEAVY NUCLEI OF COSMIC RADIATION IN JUNE, 1963 OVER FORT CHURCHILL
V. S. Bhatia, V. S. Chohan, and S. D. Pabbi *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 115–120 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The composition and energy spectra of heavy nuclei ($Z \geq 3$) of the primary cosmic rays was studied by examination of a stack of nuclear emulsions of different sensitivities exposed in June 1963 at 4.3 gm/cm^2 of residual atmosphere over Fort Churchill, Canada. Analysis of 223 tracks of $Z \geq 3$ is reported. Emphasis has been placed on the assignment of individual charges and the determination of fluxes and L/S ratios on top of atmosphere. These L/S ratios for nuclei of K.E/nucl. ≤ 600 MeV/$_n$ and > 600 MeV/$_n$ are 0.31 ± 0.10 and 0.18 ± 0.05, respectively. From these values the amount of interstellar matter traversed by cosmic rays is (4.5 ± 1.5) gm/cm^2 and (2.7 ± 0.8) gm/cm^2, respectively. It appears that the amount of interstellar matter traversed by low energy heavy primaries is greater than that for primaries of high energy. Author

N66-35398# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VERY LOW ENERGY COSMIC RAY HEAVY NUCLEI
C. E. Fichtel, D. E. Guss, K. A. Neelakantan, and D. V. Reames *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 121–126 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

In sounding rocket experiments flown from Fort Churchill in September 1963 and July 1964, finite fluxes of cosmic ray heavy nuclei were detected at energies below the experimental energy cut-off of balloon-borne experiments. The particles were examined by extending large sheets of nuclear emulsions from the sides of the rocket during its period outside the atmosphere. The flux of medium nuclei ($6 \leq Z \leq 9$, Z=nuclear charge) in the energy range from 30 to 150 MeV/nucleon was 0.67 ± 0.13 per m^2 sec. sterad in September 1963 and 1.17 ± 0.16 per m^2 sec. sterad in July 1964. Finite fluxes of light nuclei ($3 \leq Z \leq 5$), and heavy nuclei ($10 \leq Z \leq 28$) were also seen in the 30 to 100 MeV/nucleon and 40 to 295 MeV/nucleon region, respectively. Author

N66-35399# Tata Inst. of Fundamental Research, Bombay (India).
THE COMPOSITION OF THE "SOURCE" OF COSMIC RAYS
M. V. Krishna Apparao and S. Ramadurai *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementaty Particle Phys. and Astrophys [1966] p 127–134 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

When cosmic ray nuclei traverse through interstellar and interplanetary space during their propagation from their source to the earth, their composition and energy spectra are modified. Assuming certain composition for the cosmic ray sources, the relative abundances of the cosmic ray nuclei at the earth are obtained taking into account the effect of ionization and spallation losses during their propagation in the interstellar space. Since these ratios are independent of solar modulation they are compared with the ratios obtained for the various charge groups by experiments at the earth. From this comparison, conclusions are drawn about the composition of the sources, and this composition is compared with the composition of various astronomical objects determined by other means. Author

N66-35400# Jodhpur Univ. (India). Dept. of Physics.
EFFECT OF GRAVITATION IN THE ORIGIN OF COSMIC PARTICLES
M. C. Durgapal and G. L. Gehlot *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 135–142 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A theory is advanced which attributes the origin of a large number of cosmic particles to the effects of gravitation; and Schroedinger's wave equations in one and three dimensions are used to determine gravitational potential. To illustrate the theory, the Schwarzschild interior field static model in isotropic coordinates is used; and it is shown that the decay of stars results in large numbers of particles which are scattered at random, and that some of these particles enter the earth's atmosphere in the form of cosmic rays. The process by which the particles are emitted under the effect of gravitation is examined, and the period of emission and disintegration constants are calculated. Attention is also given to solutions of Einstein's field equations using the static model. M.W.R.

N66-35401# Physical Research Lab., Ahmedabad (India).
COSMIC RAY CHARGED PARTICLES AND PHOTONS IN THE ATMOSPHERE
K. Kasturirangan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 143–151 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A detector unit consisting of seven G-M counters in a ring geometry was flown by a polyethylene balloon of volume 1.21×10^3 M^3. The balloon attained an altitude of 78,000 ft., corresponding to 31 mb. Fluxes of the charged and photonic component of the cosmic rays in the atmosphere were obtained separately. The data was transmitted to the ground by FM/FM telemetry. Author

N66-35402# Tata Inst. of Fundamental Research, Bombay (India).
EAST–WEST AND NORTH–SOUTH ASYMMETRIES OF PRIMARY COSMIC RADIATION
G. S. Gokhale, P. K. Kunte, and R. Sunder Rajan *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 152–194 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The east–west and north–south asymmetries of primary cosmic radiation over Hyderabad, 8°N, as determined by an oriented double telescope instrument, are presented. Implications of the results on the geomagnetic theory are discussed. Author

N66-35403# Physical Research Lab., Ahmedabad (India).
SOME CHARACTERISTICS OF THE DAILY VARIATION OF COSMIC RAY INTENSITY
R. P. Kane *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 194–204 refs (See N66-35386 21-29)

Characteristics of the daily variation of the nucleonic component of cosmic ray intensity are studied by different methods for the quiet-sun period 1964, and for I.G.Y. It is found that the daily variation consists mostly of linear gradients (constant rate of increase or decrease per hour), which end up in sharp or broad maxima or minima (sources or sinks) whose origins are most probably outside the geomagnetic field and of an energy-independent spectrum. The average directions of the source and sink are 18 hr and 6 hr (L.T.), respectively, but variations of ± 2 hr or more are observed from day to day. The amplitude also varies widely. A partial independence of the source and sink is indicated. There is no major dependence on solar activity except that phases are sharper in the quiet-sun period. Author

N66-35404# Osmania Univ., Hyderabad (India). Dept. of Physics.

DIURNAL VARIATION OF COSMIC RAYS DURING THE DECLINE PERIOD OF SOLAR ACTIVITY

D. S. R. Murty, Y. Nagabhushanam, and K. Ramanuja Rao *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 205–209 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The yearly mean diurnal amplitude and phase for the neutron monitor data obtained from ten different stations for the year 1962 are calculated. The results reveal that the amplitude of the diurnal variation increases with geomagnetic latitude up to about 65° and falls off at higher latitudes, in general agreement with the IGY results and those predicted theoretically. However, these results also show that further analysis of the observations at higher latitudes is needed to observe any changes in the distribution of the power of the source perpendicular to the plane of the ecliptic. The results also show the shift in the phase of the diurnal variation to later hours with increasing geomagnetic latitude from the equator. Author

N66-35405# Physical Research Lab., Ahmedabad (India).

CHANGES IN THE CHARACTERISTICS OF THE ANISOTROPY OF GALACTIC COSMIC RAYS WITH SOLAR ACTIVITY

G. Subramanian, Vikram Sarabhai, and Dinesh Patel *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle phys. and Astrophys. [1966] p 210–216 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Results are obtained for rigorous study of the cosmic ray anisotropy by considering only those days on which good resolution is possible in the determination of the spectrum of variation. Two groups are obtained; for the first, the exponent ranges from 0 to −1.0 while E_{min} has a value 2 GeV and; for the other, the exponent ranges from +1.0 to −1.0 while E_{min}=15 GeV. With declining solar activity the number of days in Group I (E_{min}=2 GeV) increases by 10% and in Group II (E_{min}=15 GeV) decreases by the same amount. Other characteristics of the anisotropy remain unchanged with solar activity. The semidiurnal component is more predominant in Group II than in Group I. Author

N66-35406# Physical Research Lab., Ahmedabad (India).

AN EXPLANATION OF THE SEMIDIURNAL ANISOTROPY OF GALACTIC COSMIC RAYS

G. Subramanian and V. Sarabhai *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 217–227 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A semidiurnal variation of small magnitude and variability is observed in cosmic ray intensity, and observations perpendicular to the spiralling magnetic field give higher cosmic ray densities than does scanning along the solar equatorial plane. This increased density at a distance of a gyroradius above or below the equatorial plane gives rise to a semidiurnal anisotropy at a detector on the spinning earth, with maximum density existing perpendicular to the magnetic field. It is concluded that stronger anisotropy should be observed for higher energy particles; and that the dependence of the anisotropy on the asymptotic latitude of viewing should result in more pronounced semidiurnal anisotropy at equatorial stations. M.W.R.

N66-35407# Tata Inst. of Fundamental Research, Bombay (India).

ON INTERPLANETARY MEDIUM

S. P. Tarafdar *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 228–239 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The physical properties of the interplanetary medium are discussed from two different considerations, assuming polytropic law for the temperature. One of them is that the gas kinetic pressure in the interplanetary medium is much higher than the magnetic pressure. Although this consideration gives the observed magnitude of the magnetic field, velocity, and particle density at earth's orbit, it is shown that there are some drawbacks of this weak field model. The alternative approach is based on the assumption that the magnetic pressure is much higher than the gas kinetic pressure. Starting with this idea, the physical properties of the interplanetary medium have been worked out. This strong field model is shown to have all the merits of the weak field model, but none of its drawbacks. Author

N66-35408# Physical Research Lab., Ahmedabad (India).

THE TEMPORAL INDEPENDENCE OF THE OCCURRENCE OF SMALL SCALE IRREGULARITIES IN THE INTERPLANETARY MAGNETIC FIELD

U. R. Rao and K. G. Mc Cracken (Southwest Center for Advanced Studies) *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 240–247 refs Prepared jointly with Southwest Center for Advanced Studies (See N66-35386 21-29)

(Grant NSF GP-926) CFSTI: HC $11.65/MF $4.25

From a critical examination of the cosmic ray daily variation observed by various neutron monitors all over the world, it is concluded that the frequency of occurrence and the characteristics of small scale magnetic field irregularities in the interplanetary plasma are independent of the phase of the sunspot cycle. Author

N66-35409# Physical Research Lab., Ahmedabad (India).

SECTOR STRUCTURE OF SOLAR ACTIVITY AND THE ELECTROMAGNETIC CONDITIONS OF INTERPLANETARY SPACE

P. N. Pathak, V. Sarabhai, and G. Subramanian *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 248–253 refs Sponsored by Dept. of Atomic Energy, India (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The sector structure of the interplanetary magnetic field as revealed by the IMP-1 satellite is compared with a derived index of the coronal 5303Å emission intensity at the solar equator. It is observed that sectors where the magnetic field lines point outwards from the sun are associated with highly excited regions where the solar wind velocity is enhanced. The correlated changes in K_p and cosmic ray intensity show that high K_p is caused by at least two different types of interplanetary conditions. In one case where high K_p is associated with decreases of cosmic ray intensity, coronal conditions indicate the development of a shock transition due to fast wind blowing behind slow. In the other condition when high K_p occurs with recovery of cosmic ray intensity, the earth emerges out of a "cavity" which develops due to slow plasma following fast plasma. Author

N66-35410# Tata Inst. of Fundamental Research, Bombay (India).

CORRELATION BETWEEN THE ELECTRON, MUON AND N-COMPONENTS IN EXTENSIVE AIR SHOWERS

B. K. Chatterjee, G. T. Murthy, S. Naranan, B. V. Sreekantan, M. V. Srinivasa Rao et al *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 292–298 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

With an air shower array of 2.2 km altitude, the energy spectrum of high energy N-particles >50 GeV has been determined for showers ranging from a few times 10^4 to 10^7

particles. Classification according to shower size and steepness of the electron lateral distribution was made. It is found that the number of high energy N-particles (within 10 m) is significantly less in showers which have a flat electron lateral distribution than in steep showers in the same size. Strong correlations in the lateral distributions of N-particles, muons, and electrons had been reported earlier. It is also found that the variation of the total number of N-particles with size may be expressed as $N_n \propto N^m$, and m has a value of ~0.7. The low energy N-component and muon component also have a similar dependence on shower size. Author

N66-35411# Tata Inst. of Fundamental Research, Bombay (India).
PROPERTIES OF EXTENSIVE AIR SHOWERS RICH IN MUONS
B. K. Chatterjee, G. T. Murthy, S. Naranan, B. V. Sreekantan, M. V. Srinivasa Rao et al *In* India. Dept of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 299–306 ref (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The properties of extensive air showers selected by the four-fold coincidence of four muon detectors mutually separated by ~ 20 m, without any restriction on the associated electron component, were studied at mountain altitude. It is found that the zenith angle distribution of mu-triggered showers is very flat compared to the showers selected by requirements of electron density, particularly at sizes lower than 10^6. This indicates that the showers selected by mu-trigger are relatively rich in muons; for sizes $>10^6$ mu-triggered showers are not necessarily mu-rich. A plot of the arrival direction of showers in celestial coordinates does not reveal any marked anisotropies in either the electron-triggered showers or mu-triggered showers, even in the size range 10^5 to 10^6. A study of the variation of the energy flow in the soft component and in the nuclear active component close to the core reveals that in showers of size $\lesssim 10^6$ the energy flow in both components is much lower in mu-triggered showers than in electron-triggered showers. This difference is more conspicuous in the case of the N-component. Author

N66-35412# Tata Inst. of Fundamental Research, Bombay (India).
ULTRA HIGH ENERGY MUONS (>200 GeV) IN EXTENSIVE AIR SHOWERS
B. K. Chatterjee, S. Lal, T. Matano, G. T. Murthy, S. Naranan et al *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p307–314 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The absolute number of muons of energy >220 GeV and >640 GeV have been estimated in showers of size 10^5 to 10^6 (primary energy 10^{15} to 10^{16} ev), using a large air shower array on the surface, and muon detectors deep underground in the Kolar Gold Mines (13°N, 920 g cm^{-2}), India. The implications, in particular the slow increase of N_u with size, with reference to multiplicity of pions in nuclear collisions is discussed. The frequency of multiple muons is consistent with a mean production height of 10 km, and the distribution of arrival directions of showers with high energy muons in right ascension shows no deviation from an uniform distribution. Author

N66-35413# Tata Inst. of Fundamental Research, Bombay (India).
TIME LAGS OF NUCLEAR INTERACTING PARTICLES IN EXTENSIVE AIR SHOWERS
B. K. Chatterjee, G. T. Murthy, S. Naranan, B. V. Sreekantan, M. V. Srinivasa Rao et al *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 315–321 ref (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

An experiment has been carried out at 2.2 km altitude to determine the time lags with respect to the shower front of nuclear interacting particles of various energies. A total absorption spectrometer of area 1.4 sq. metre has been operated at the center of an air shower array. Delays of interacting particles of energy ≥ 5 GeV have been measured up to a maximum delay of ~300 nanoseconds. The results show: (1) peak of all nuclear interacting particles of energy ≥ 5 GeV is displaced with respect to the shower front by ~20 nanoseconds, (2) the average delay is a function of the average energy of the particles, and (3) while nearly 30% of the particles of energy ≥ 5 GeV are delayed by more than 50 nanoseconds, only ~0.4% are delayed beyond 100 nanoseconds. The tail extends to 250 nanoseconds. These features quite definitely rule out the possibility that nuclear active particles of energy ≥ 5 GeV are are predominantly pions, and suggest the production of large numbers of nucleon-antinucleon pairs in air showers. Author

N66-35414# Tata Inst. of Fundamental Research, Bombay (India).
SEARCH FOR HEAVY MASS PARTICLES IN AIR SHOWERS
B. K. Chatterjee, G. T. Murthy, S. Naranan, B. V. Sreekantan, M. V. Srinivasa Rao et al *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 322–330 refs (See N66-35386 21–29) CFSTI: HC $11.65/MF $4.25

An experimental search has been made at an altitude 2.2 km employing a total absorption spectrometer at the center of an air shower array to determine the presence of delayed high energy interacting particles in the interval 60 to 300 nanoseconds. In 449 hours of observation (~80,000 showers of size 10^4 to 10^7) there was no evidence for the passage of a heavy mass particle through the total absorption spectrometer of mass particle through the total absorption spectrometer area 1.5 square meters. Author

N66-35415# Tata Inst. of Fundamental Research, Bombay (India).
ARRIVAL TIME DISTRIBUTIONS OF HEAVY PARTICLES IN AIR SHOWERS
Yash Pal and S. N. Tandon *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 331–341 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Arrival time distributions of nucleons and other hypothetical heavy particles of various energies in air showers have been calculated, taking into account fluctuations in the positions of various interactions. Production and propagation of these particles are characterized, and their fluxes for different time delays are obtained as functions of the characterized parameters. It is found that a significant fraction of nucleons and antinucleons of energy ~10 GeV arrive with time delays greater than 100 nanoseconds. Author

N66-35416# Tata Inst. of Fundamental Research, Bombay (India).
POSSIBLE FLUX OF HEAVY TRIPLETS, ETC, IN COSMIC RADIATION AND THEIR DETECTION
Yash Pal and S. N. Tandon *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 342–349 refs (See N66-35386 21–29) CFSTI: HC $11.65/MF $4.25

Possible flux of hypothetical heavy particles produced during high energy cosmic interaction is calculated, based on various assumptions about the production and interaction of triplets. It is assumed that the triplets are strongly interacting and have the same mean free path as nucleons, that triplets are produced as pairs in nucleon-nucleon collisions, and triplet cross section is proportional to the square of its Compton wave length. The integral flux of triplets is found to be detectable, and experimental procedures for charged and neutral particle detections are suggested. M.W.R.

N66-35417# Tata Inst. of Fundamental Research, Bombay (India).
HIGH ENERGY NUCLEAR ACTIVE AND MUONIC COMPONENTS IN EXTENSIVE AIR SHOWERS
R. Cowsik *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 350–358 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

The high energy ends of the nuclear-active and muonic components in air showers are senitive to the characteristics of very high energy nuclear interactions. Calculations are made on the basis of a "dual" model of high energy interactions which successfully explains the stationary aspects of cosmic ray propagation through the atmosphere. A special feature of this model is that a large fraction of non-pions produced in high energy nuclear interactions are assumed to be nucleon-antinucleon pairs. The energy spectra and growth curves of nucleons, pions and muons are presented and are compared with experimental results. Author

N66-35451# Leicester Univ. (England). Dept. of Physics.
SOLAR X-RAY STUDIES
T. B. Jones *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1965] p 751–755 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A very brief description is given of some of the solar X-ray studies currently being carried out. Also mentioned are some of the ionospheric experiments that have been specifically designed to study the effects of the solar X-radiation on the earth's atmosphere. Author

N66-35452# Kodaikanal Observatory (India).
MEASUREMENTS OF WEAK MAGNETIC AND VELOCITY FIELDS ON THE SOLAR SURFACE
J. C. Bhattacharyya *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 756–762 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

An equipment with highly sensitive photoelectric sensors has been developed for microstudy of variations in absorption line profiles in the solar spectra. The spectra are produced by a high dispersion spectrograph from light from various regions of the solar disc in the 37 m solar telescope in Kodaikanal Observatory. By using electro-optic circular polarization detectors, distortions in the profile of magnetically sensitive lines have been measured, giving quantitatively the longitudinal component of magnetic field over various regions on the sun. With electro-optic chopping arrangement, the Doppler shift of absorption lines has also been measured to study the oscillatory velocity fields. Author

N66-35453# Indian Inst. of Science, Bangalore. Dept. of Physics.
STUDIES OF THE ENHANCED SOLAR RADIO EMISSIONS ON METER WAVELENGTHS
S. B. S. Subrahmanya Sarma *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 763–773 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Using a simple radio telescope and the associated recording equipment, the sutdy of enhanced solar radio emissions on meter wave lengths has been discussed. Some aspects of the radio noise storms (type I bursts), and type II and type IV bursts have been discussed. The method of obtaining the velocity of shock wave front responsible for the type II burst radiation has been given. Solar continuum radiation (type IV bursts) at this meter wave length has showed an interesting property in which the intensity of radiation has shown a smooth exponential fall in all the cases. Using this result an approximate method of estimating the magnetic fields (order of magnitude) in the solar corona at the plasma level, during the type IV events has been indicated. Author

N66-35454# Tata Inst. of Fundamental Research, Bombay (India).
HIGH RESOLUTION STUDIES OF THE SUN AT A FREQUENCY OF 612 MC/S
G. Swarup, V. K. Kapahi, J. D. Isloor, and R. P. Sinha *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 774–781 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Two multi-element interferometers having beam widths of 2.3 and 5 minutes of arc in east–west and north–south directions respectively have been constructed for radio observations of the sun at a frequency of about 612 Mc/s. Each interferometer uses a simple highly dispersive transmission line of the traveling wave type which can allow multiple-beams by making observations at slightly different frequencies. A strip scan across the quiet sun in an east–west direction has been derived. It shows that the radio sun around 50 cm wavelength has sharper features, perhaps more limb-brightening, than that derived using a 2-element interferometer. Author

N66-35458# Tata Inst. of Fundamental Research, Bombay (India).
A STUDY OF SOLAR NEUTRONS
P. J. Lavakare *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 804–809 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

Theoretical and experimental researches related to solar neutrons are reviewed, including various speculations related to the production of neutrons. Threshold energy yield of solar neutrons per solar flare proton is tabulated for proton-initiated and alpha-particle initiated reactions. A experiment is reported on the detection of solar neutrons by nuclear emulsions. After applying the necessary correction for secondary neutron production, it is concluded that the flux of neutrons of solar origin is 148 ± 60 neutrons/m^2.sec in the 20 to 160 MeV interval. Corresponding flux of solar neutrons in the low energy interval of four to 20 MeV is about 2 ± 14 neutrons/m^2 sec. To overcome the continuous sensitivity of the nuclear emulsion detector, a high energy neutron detector for use in balloon flights has been developed. M.W.R.

N66-35489# Chicago Univ., Ill. Lab. for Astrophysics and Space Research.
COSMIC RAY NEUTRON INTENSITY MONITOR
John A. Simpson *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 15–22 refs (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Tabulated data recorded by cosmic ray neutron intensity monitors at stations in Chicago, Illinois and Climax, Colorado for October through December of 1965 are presented. R.N.A.

N66-35490# New Hampshire Univ., Durham.
COSMIC RAY NEUTRON INTENSITY MONITOR
John A. Lockwood *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 23–74 refs (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Data from an IQSY-NM-64 cosmic ray neutron intensity monitor recorded at the University of New Hampshire, Durham, New Hampshire, for the 18 month period beginning July 1, 1964 are presented. An errata sheet correcting the Mount Washington data for 13 and 28 July 1965 precedes the tabulated data. The cosmic ray data are given in universal time with the hourly counting rates corrected for barometric pressure. The data printout sheets list a normalization factor to compensate for changes in the operation of the monitor. R.N.A.

N66-35503# Aerospace Corp., El Segundo, Calif.
TRAPPED RADIATION MODEL ENVIRONMENTS
James I. Vette *In* AFCRL Geophys. and Space Data Bull., Vol II, No. 4 1965 p 207–315 refs Supported in Part by NASA (See N66-35486 20–13) CFSTI: HC $6.00/MF $0.50

The latest series of trapped radiation model environments is presented. Four proton models (AP1, AP2, AP3, and AP4) covering different energy ranges above 4 MeV, and an electron model AE2 covering the spatial region out to 6 earth radii, are included. The data used to construct these models are given in Tables 1, 2, and 3. To provide guidance in projecting future trapped radiation model environments, an estimated environment for December 1968 was prepared by decaying inner zone electrons and increasing outer zone fluxes to represent solar maximum conditions. The orbital integration table for this environment is given. R.N.A.

N66-35561# Maryland Univ., College Park. Dept. of Physics and Astronomy.
ELECTROSTATIC POTENTIAL OF A COSMIC DUST PARTICLE
John W. Rhee Aug. 1966 35 p
(Grant NSF GY-670)
(TR-596)

An attempt was made to compute the equilibrium potential of a cosmic dust particle in interplanetary space. The equilibrium potential was determined by the balance of the photoelectrons and thermal plasma only. The contribution to the potential from the protons was shown to be small and can be neglected in interplanetary space. The preliminary data indicated that the maximum potential at 1 A.U. is 6.6 V, 5.7 V at 2 A.U., and 5.3 V at 3 A.U. The potential must be of the same order of magnitude at the other distances. Author

N66-35599*# Geological Survey, Washington, D. C.
LUNAR INFRARED EMISSION STUDY
Kenneth Watson *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 29–33b refs (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00

Following a chronological review of various attempts to measure lunar infrared emission, an outline is presented of the program conducted by the Astrogeology Branch of the Department of Interior. Information obtained from temporal and spectral distributions of the infrared emission will be utilized to provide a more accurate interpretation of lunar surface geology. The main lines for investigation will be broadband emission from the moon through two major vapor windows from 8–14 μ and 18–24 μ, and narrowband emission within these windows. Models to explain lunar infrared emission will include lateral and vertical variations in thermal properties which are consistent with the surface geology, as well as temperature dependence of both thermal conductivity and specific heat. Studies are underway on the use of models of the lunar photometric function to derive the variation of absorbed solar energy as a function of the sun's elevation. M.W.R.

N66-35673# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
INSTRUMENTS FOR THE OBSERVATION OF GALACTIC X-RAYS
Masaru Matsuoka Jun. 1966 37 p refs *Its* Vol. 31, No. 4 (ISAS-403) CFSTI: HC $2.00/MF $0.50

Three types of rocket-borne X-ray instruments were constructed; they consist of a scintillation counter, four proportional counters and twenty-three GM counters respectively. The scintillation counter was used to observe isotropic X-rays in the energy ranges of 5–10, 10–15, 15–20 and $\geq$20 KeV, and the proportional counters to observe the intensities of X-rays from several sources in the energy ranges of 2–4, 4–8 and 8–16 KeV. The GM counters were used to observe the intensities of X-rays from several sources in the wavelength ranges of 2–4, 4–8 and 7–11 Å. Their properties were tested by radioactive sources and were found to be suitable to analyze the energy spectrum of galactic X-rays and to reject charged particles. Their counter systems were successful to obtain several data of galactic X-rays and atmospheric X-rays, and the method of data analyses as well as preliminary results are also described. Author

N66-35685*# Aerospace Corp., El Segundo, Calif.
MODELS OF THE TRAPPED RADIATION ENVIRONMENT VOLUME II: INNER AND OUTER ZONE ELECTRONS
James I. Vette, Antonio B. Lucero, and Jon A. Wright Washington, NASA, 1966 100 p refs Supported in part by NASA (Contract AF 04(695)-469)
(NASA-SP-3024) CFSTI: HC $1.00/MF $0.75 CSCL 04A

Graphs and tables of data for the electron environment AE2, which cover both inner and outer zone out to L=6.0 for the time period around August 1964, are presented. Data for electron energy spectra, distribution, and orbital integrations are included. N.E.N.

N66-35690# Academy of Sciences (USSR), Moscow.
INTERPLANETARY PLASMA (SOLAR WIND). COMPARATIVE SIMULTANEOUS MEASURING OF MAGNETIC FIELDS AND CURRENTS OF IONS INSIDE THE MAGNETOSPHERE OF THE EARTH–INSTRUMENTATION ON ELEKTRON; II SATELLITE
K. I. Gringauz, et al 1965 9 p refs In RUSSIAN Presented at Moscow, 10–16 Jun. 1965 Reprinted
CFSTI: HC $1.00/MF $0.50

Previous theories and findings on interplanetary plasma, solar corona, and magnetic fields are reviewed, and two models–one static, the other dynamic–are discussed. The findings are then analyzed in the light of recent experiments on U.S. and Soviet satellites and space probes. Mentioned are measurements of solar plasma and geomagnetic perturbation, and identification of protons in solar plasma is discussed. Flow data and the Doppler effect in signal spectrum are considered. The second article briefly recapitulates launching and orbital data of Elektron II and lists its instrumentation. Characteristics and calibration of a three-electrode charged particle counter and a magnetometer, their potential, registration capacity, and photoelectron and ion measurements, are discussed. Magnetic perturbation measurements during given periods are discussed and shown in graphs. Results are compared with proton energy data collected by the U.S. Explorer XII satellite. Diurnal variations in the collected data are analyzed and correlated. Transl. by K.W.

N66-35730*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
X-RAY AND Γ-RAY ASTRONOMY
Minoru Oda (Tokyo Univ.) [1965] 55 p refs Presented at the Cosmic Ray Conf., London, 6–17 Sep. 1965
(Grant NsG-386; Contract AT(30-1)-2098)
(NASA-CR-68523) CFSTI: HC $3.00/MF $0.50 CSCL 20H

Observational facts and related arguments concerning X-rays and γ-rays available in the past few years, are reviewed and discussed. First, observational methods are briefly summarized. Next, a review of the many unexpected results of observational facts of cosmic X-rays in the 1 ≈ 10 keV range is presented. Physical processes of X-ray generation in discrete X-ray sources are briefly discussed. While the discovered discrete X-ray sources are in the galactic plane, an isotropic component that is likely of extragalactic origin seems to exist. Observations of radiation from several tens of keV up to γ-ray energies are reviewed. Though no γ-rays of proven cosmic origin have been detected, upper limits set for various suspected discrete sources and the isotropic component have considerable physical significance. Author

N66-35775*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

SPATIAL DISTRIBUTION OF ENERGETIC ELECTRONS IN THE GEOMAGNETIC TAIL

Takashi Murayama Jun. 1966 41 p refs

(Grant NSG-179-61; Contracts AF 19(628)-2473; AF-49 (638)-1462)

(NASA-CR-77630; EFINS-66-64) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Counting rates from a solid state detector in the experiment of Fan, Gloeckler and Simpson on the IMP-1 satellite have been analyzed to investigate the spatial distribution of electrons with energies >30 kev in the geomagnetic tail and in the magnetosheath region surrounding the tail out to ≈30 earth radii. The counting rates range from the background cosmic ray level ($\approx 3\ sec^{-1}$) up to $10^3 sec^{-1}$ and have a positive correlation with the K_p geomagnetic field disturbance index. A multiple correlation analysis was made to investigate the spatial distribution of the electrons within the tail, which leads to the following results: (1) the particle flux is a decreasing function of Z_n, the distance from the neutral sheet as determined by magnetic field observations on the same satellite by Ness, Scearce and Seek. Z_n is found to be a better parameter for describing the electron distribution than the distance from either the ecliptic plane or the geomagnetic equatorial plane; (2) the radial dependence of the electron flux reported earlier by Anderson is shown to be due mostly to the spurious correlation between the radial distance and Z_n; (3) for a given constant Z_n, the flux is higher near the dawn-side magnetospheric boundary than near the center of the tail. In the magnetosheath beyond the boundary of the tail, the electron flux decreases only gradually with increasing distance from the solar magnetospheric equatorial plane. The implications of these observations are discussed mainly in connection with the origin of the energetic electrons in the tail. Author

N66-35802*# California Univ., La Jolla. Dept. of Physics.

PROCESSES ACTING UPON OUTER ZONE ELECTRONS. I. ADIABATIC PERTURBATIONS

C. E. Mc Illwain 1 Sep. 1966 30 p refs Presented at Inter-Union Symp. on Solar-Terrest. Phys., Belgrade, 1 Sep. 1966

(Grant NsG-538)

(NASA-CR-77577; UCSD-SP-66-5) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Five distinct types of processes have been found which cause time variations in the energetic electron fluxes in the outer zone. It is shown how the combined action of these processes can produce the observed time dependences. One process has been definitely identified as being due to a specific physical mechanism, namely, adiabatic betatron acceleration. It is found that changes in both the ring current field and the magnetospheric boundary current field produce predictable changes in the particle fluxes. An example of how trapped particle measurements can be used to compute relatively accurate Dst values is presented. Since the adiabatic effects are predictable, they can be removed to exhibit the non-adiabatic effects more clearly. Using this technique, an occurence of enhanced loss has been found which may be due to the instability predicted by Kennel and Petschek. Author

N66-36007# Pennsylvania State Univ., University Park. Radio Astronomy Observatory.

SOLAR RADIO FLUX DURING THE IQSY AT UNIVERSITY PARK, PENNSYLVANIA Quarterly Report, Jan.–Mar. 1966

John P. Hagen Jul. 1966 46 p

(Grant NSF GP-2986)

(SR-005)

This report contains solar radio flux data recorded at 10,700 Mc/s, 2,700 Mc/s 960 Mc/s and 328 Mc/s, during the quarter 1 January 1966 to 31 March 1966. A table of distinct events is also given. Author

N66-36032# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.

AN IONOSPHERIC ESTIMATE OF NITRIC OXIDE CONCENTRATION IN THE D-REGION Scientific Report No. 265

Ashesh P. Mitra 15 Feb. 1966 27 p refs

(Contract AF 19(628)-4014; Grant NSF GP-5611)

(AFCRL-66-359; AD-635603) CFSTI: HC $1.00/MF $0.50

It is shown that the dissimilar nature in the solar-cycle variations in the three major competing ionizing sources for the d-region (e.g. X-rays below 8Å, [L_α] and cosmic rays) can be used to provide an estimate for the concentration of the neutral nitric oxide at and near 70 km. Use of the electron density profiles recently given by Deeks for sunspot minimum and maximum conditions for equinox in middle latitudes gives a nitric oxide concentration of [$4\times10^5/cm^3$] around 72 km, about one hundredth of Barth's rocket-deduced value. When this value is integrated with currently available photochemical information, the following empirical distribution is indicated: N(NO)=0.02 exp[−3300/T)N(02)+0.0000005N(O). Author (TAB)

N66-36065*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE PROPAGATION OF LOW ENERGY CHARGED PARTICLES IN THE INNER SOLAR SYSTEM

V. K. Balasubrahmanyan and G. Skadron (Md. Univ.)

Aug. 1966 41 p refs Prepared in cooperation with Md. Univ.

(Grant NsG-695)

(NASA-TM-X-57880; X-611-66-365) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The effects of particle drift, diffusion, and convection are used to describe the propagation of solar charged particles in the inner solar system. It is found that protons and electrons gradient drift in opposite polar directions in the interplanetary magnetic field; and although the charge separation thereby produced is very small, this drift determines the energy loss of these particles. In addition, it is shown that electric field drift causes protons and electrons, alike, to corotate but slower than the magnetic field structure. As a result, solar particles injected onto a given magnetic field line sweep past the earth later than the field line. The resulting azimuthal intensity profile is determined by the distribution of sun-earth transit times for these particles as they diffuse along the magnetic field lines. These considerations are applied to low energy protons and electrons and predictions for their energy loss and intensity profiles are made. A comparison of these predictions with the data from the Imp 1 satellite indicates that the observed recurrent protons might be understood in terms of this analysis if the diffusion is sufficiently slow to give 1 Mev protons a 4 day transit time. The observed electrons, however, cannot have had such a solar origin and are evidently galactic. Author

N66-36324*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PROBABILITIES OF SOLAR FLARE OCCURRENCE

William T. Roberts 18 May 1966 20 p refs

(NASA-TM-X-53463) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The primary interest vehicle designers and advanced mission planners have in solar flares is the probability of occurrence of a damaging flare. Obviously then, one must define exactly what is a damaging flare. An environmental model of a "typical" flare is constructed herein, and the probability of occurrence of this or a similar flare is considered. The next step is to then derive an "extreme" model solar flare so that the effects of such a flare on occupants of a nominally shielded vehicle may be derived. Since this report is intended to present only the environmental model, no attempt has been made to estimate the dose accrued for either type flare nor have any shielding calculations been performed. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-35455# Osmania Univ., Hyderabad (India). Nizamiah Observatory.

ABSORPTION LINES IN MOVING STELLAR ENVELOPES

K. D. Abhyankar *In* India. Dept. of Atomic Energy Proc. of The 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 782–789 refs (See N66-35385 21-29) CFSTI: HC $11.65/MF %4.25

Various kinds of mass motions in stellar atmospheres are reviewed. After pointing out the difficulties in the problem of the production of absorption lines in moving atmospheres a numerical method for computing such absorption line profiles is described. The method is applicable to any scattering function and any monotonic velocity law. Some typical results are presented. Variation of the line profile over the disk of the star is discussed and integrated line profiles are given. It is concluded that the bewildering variety of line profiles in supergiant stars like ϵ Aur can be understood with the hypothesis of a field of prominences on their surfaces. Author

N66-35456# Osmania Univ., Hyderabad (India). Nizamiah Observatory.

A STUDY OF ζ Cr B A

K. D. Abhyankar and M. B. K. Sarma *In* India. Dept.of Atomic Energy Proc. of The 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 790–795 refs (See N66-35386 20-29) CFSTI: HC $11.65/MF $4.25

New spectroscopic observations of ζ CrB A are presented. Old and new results about the elements of the orbit are compared. It is inferred that the secondary may be on its way to becoming unstable. Author

N66-35457# Osmania Univ., Hyderabad (India). Nizamiah Observatory.

THE DYNAMICS OF COLLIDING GALAXIES

Saleh Mohamed Alladin *In* India. Dept. of Atomic Energy Proc. of the 9th Symp. on Cosmic Rays, Elementary Particle Phys. and Astrophys. [1966] p 796–803 refs (See N66-35386 21-29) CFSTI: HC $11.65/MF $4.25

A theory is developed for the motions of colliding galaxies treating the galaxies as spherically symmetric distributions of stars, and a method is described for estimating the exchange of energy during a collision of galaxies between that corresponding to the center-of-mass motions of the galaxies and that due to their internal structures and motions. Certain implications of the results obtained are mentioned and a program of further research is suggested. Author

N66-35495# Sacramento Peak Observatory, Sunspot, N. Mex.

SOLAR OPTICAL PATROL OBSERVATIONS

Howard L. de Mastus *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 101–154 (See N66-35486 20-13) CFSTI: HC $6.00/MF $0.50

Solar optical patrol observations made by the Sacramento Peak Observatory at Sunspot, New Mexico from October through December of 1965 are listed. The observations include chromospheric flares, flare film record, chromospheric activity other than flares, white light visual sunspot drawing, spectrographic cornonal observations, and sunspot group analysis (white light photographic patrol). R.N.A.

N66-35496# Harvard Coll. Observatory, Fort Davis, Tex. Radio Astronomy Station.

SOLAR RADIO EMISSION. SPECTRAL OBSERVATIONS

Alan Maxwell *In* AFCRL Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 155–159 (See N66-35486 20–13) CFSTI: HC $6.00/MF $0.50

Solar radio emission spectral observations made at 25 to 320 MHz at Harvard Radio Astronomy Station at Fort Davis, Texas during the period from October 1 through December 31, 1965 are tabulated. R.N.A.

N66-35497# Air Force Cambridge Research Labs., Bedford, Mass.

SOLAR RADIO EMISSION. SPECTRAL OBSERVATIONS

Ronald Straka *In its* Geophys. and Space Data Bull., Vol. II, No. 4 1965 p 161–163 (See N66-35486 20–13) CFSTI: HC $6.00/MF $0.50

Solar radio emission spectral observations made at 19 to 41 MHz at the Sagamore Hill Radio Observatory located at Hamilton, Massachusetts for October through December of 1965 are listed. Also included is a spectrogram photograph of a continuum event at sunrise on October 4, 1965. R.N.A.

N66-35508*# Air Force Academy, Colo.

PROCEEDINGS OF THE WORKING GROUP ON EXTRATERRESTRIAL RESOURCES--Fourth Annual Meeting

[1965] 550 p refs Meeting held 29 Nov.–2 Dec. 1965 (NASA-CR-77328) CFSTI: HC $8.50/MF $2.75 CSCL 22A

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PROJECT SUPER

20. PROJECT SUPER M. V. Vasilik (Arnold Eng. Develop. Center) p 495–509 (See N66-35524 21-30)

N66-35507*# Air Force Academy, Colo.

TRANSIENT LUNAR EVENTS: POSSIBLE CAUSES

B. M. Middlehurst and J. Burley *In its* Proc. of the Working Group on Extraterrest. Resources 1965 p 71–76 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

A literature survey has produced records of 200 sightings of apparent activity on the moon; of these, 145 were dated. Analyses of the dates of occurrence were made. It was found that a large proportion occurred within a few days of mean perigee or mean apogee, and this suggests a relation with tidal effects due to the earth's gravitational pull. Work on this aspect is continuing. Author

N66-35508*# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

GEOMETRY OF BACKSCATTERING SURFACES AS APPLIED TO THE MOON

J. D. Halajian *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources 1965 p 78–123 refs (See N66-35506 21-30)

(Contract NAS9-3182) CFSTI: HC $8.50/MF $2.75

The relationship between the photometric and geometric properties of the lunar surface is studied by means of artificial models that lend themselves readily to controlled manipulation and analysis. Composite models consisting of dust covered geometric solids permit the study of the relative contribution of micro- and macro-roughnesses (including the effect of slopes) on the total backscatter. A simple, i.e., dust-free, model built by means of thumb tacks helps to demonstrate that shadowing on and within a dark porous structure can primarily be responsible for the backscattering exhibited by the lunar surface and that both quasi-horizontal and quasi-vertical members having a well-defined proportion and spacing appear to be necessary components of a lunar photometric model. Simple models of the thumb tacks variety help the experimenter to interpret the lunar data or their terrestrial analogs in terms of relevant properties rather than in terms of generic names (i.e., dust, cinder, slag, etc.) that often confuse the issue. Author

N66-35510*# Pennsylvania State Univ., University Park. Materials Research Lab.

LUNAR WATER RESOURCES

Jon N. Weber, G. W. Brindley, Rustum Roy, and J. H. Sharp 29 Oct. 1965 *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources 1965 p 194–233 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

If a substance could be found on the moon from which hydrogen and oxygen could be obtained, the use of the moon as a refueling station for hydrogen fueled rockets would greatly enhance exploratory expeditions into deep space. The value of any given mineral or rock will depend on the probability of finding the substance in the vicinity of the landing area, the abundance of the mineral or rock, the amount of water contained, and the difficulty of extracting the water. These factors are used as a basis in evaluating possible sources of lunar water. The sources considered include basaltic and granitic rocks, serpentine and other hydrated minerals, and water in the solid phase trapped in permanently shaded cold spots in the polar regions. It is stated that severe limitations are imposed on the design of a program to use lunar materials for water supply because information concerning the chemical composition and distribution of minerals on the lunar surface are not yet available, and the available data on the thermodynamics and kinetics of water evolution from minerals are not directly applicable to lunar surface environments. H.S.W.

N66-35511*# Northrop Space Labs., Hawthorne, Calif.

A NOTE ON PETROLOGIC PROCESSES AND LUNAR LOGISTICS

Emanuel Azmon *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources 1965 p 234–243 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

Utilization of lunar natural resources for support of human activities is examined through a study of petrologic processes in igneous rocks. Four groups of variables are formed to establish bulk properties: composition, temperature, pressure, and history. Rock forming systems are subdivided into 10 sets of igneous rocks that can attain a definite genetic state. A typical genesis diagram is included for gabbro, which shows the pressure and temperature of formation of the 10 genetic states. Photomicrographs of heat-treated gabbro illustrate the good correlation between the physical parameters (the variables) that define a genetic state and the recognized petrologic characteristics of the rock. Benefits derived from the knowledge of processes and conditions for the formation of igneous rocks are listed as the ability to generate rock end products at will and to determine the provenance of a natural rock. S.P.

N66-35512*# Little (Arthur D.), Inc., Cambridge, Mass.

CRYOGENIC STORAGE ON THE MOON

Peter F. Strong, Peter E. Glaser, Frank Gabron, and Carrol H. Sox *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources (1965) p 244–268 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

To assess the problems anticipated in storing cryogenic fluids on the surface of the moon for extended periods, methods are presented for estimating heat inputs to a storage vessel exposed to the lunar environment and for quantitatively predicting

the expected boil-off losses. The radiation interchange with the lunar surface was identified in terms of the observed lunar surface photometric properties and the results were compared with radiation from a surface obeying Lambert's law. The lunar surface characteristics of importance to cryogenic storage, the selection of appropriate support concepts, the performance of highly effective thermal insulations, and the treatment of piping penetrations to reduce performance degradations are discussed. Results are presented of analyses of the heat exchange for the computation of environment heat of fluxes and the boil-off rate is estimated for a specific cryogenic vessel design. Author

N66-35513*# Naval Ordnance Test Station, China Lake, Calif.
LUNAR GEOTHERMAL POWER: SOME PROBLEMS AND POTENTIALS
Carl F. Austin, J. Kenneth Pringle, and Richard D. Fulmer *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 269–288 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

Power from geothermal deposits on earth is an established fact, with plant capacities ranging from a few kilowatts to several hundred megawatts. The increasing evidence for contemporary volcanic and fumarolic activity on the moon lends strong support to the validity of the concepts of utilizing geothermal fluids as a source of lunar power. Geothermal energy, whatever the size of installation desired, will probably not be an energy source during early exploratory operations, because of the inherent uncertainty in developing natural resources. On the other hand, the attractiveness of geothermal concepts with their abundant potential for byproduct fuel and life-support production, plus the potential for large continuous power outputs, suggests that the location and testing of areas of geothermal potential should be an early goal for lunar exploration efforts. This paper describes the chemical and structural properties of geothermal deposits and outlines the differences expected between lunar and terrestrial deposits and their surface expressions. Author

N66-35515*# National Aeronautics and Space Administration, Washington, D. C.
IMPULSE PROPULSION GAINS RESULTING FROM "FREE" RETANKING OF PROPELLANTS ON VARIOUS ORBITS AND STATIONS AT THE EARTH, THE MOON, MARS, AND VENUS
Rollins W. Gillespie *In* AF Acad. Proc. of the Working Group on Extraterrest. Resources [1965] p 312–340 refs (See N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

The utilization of extraterrestrial resources to supply propellants for tanking rockets at various stations along the routes of round trip expeditions to the planets has been evaluated, on the assumption that the propellants are "free", in the sense that they are available at the station without cost or complication. The method used in the evaluation is to plot and compare curves showing the remaining mass fractions as functions of the hyperbolic excess speed for single-stage rockets leaving each station. Families of curves are shown for various propellants for departures from all interesting orbits and stations at the Earth, the Moon, Mars, and Venus. From these, it is possible to evaluate hundreds of individual retanking operations. Representative cases are shown. Author

N66-35524*# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
PROJECT SUPER
Michael V. Vasilik 1 Dec. 1965 *In* AF Acad. Proc. of the Working Group on Extrerrest. Resources [1965] p 495–509 (see N66-35506 21-30) CFSTI: HC $8.50/MF $2.75

The Support Program for Extraterrestrial Research (SUPER) is described as a joint effort between NASA and the Air Force to provide maximum utilization of the nation's resources in support of the space program. Objectives, background, and organization of the project are briefly discussed. Project procedures, the original nine SUPER projects initiated in FY64, and future trends are illustrated. S.P.

N66-35579# RAND Corp., Santa Monica, Calif.
REDUCTION OF THE EQUATIONS OF RADIATIVE TRANSFER FOR A PLANE-PARALLEL PLANETARY ATMOSPHERE, PART II
Zdenek Sekera Jul. 1966 69 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5056-PR; AD-635847) CFSTI: HC $6.00/MF $0.75

A presentation of mathematical techniques necessary in unique solution of equations of radiative transfer in a homogeneous atmosphere with Rayleigh scattering. The singular linear integral equations for the x- and y-matrices appearing in the azimuth-independent terms of the reflection and transmission matrices for the emerging radiation from a homogeneous, plane-parallel atmosphere with Rayleigh scattering are reduced to four pairs of scalar equations of the forms discussed by T. W. Mullikin. The nonuniqueness in the solutions of one of these pairs of equations is removed by using linear constraints. The solutions are finally expressed as linear combinations of Chandrasekhar's functions and are brought to the same form as that derived by Chandrasekhar, but by completely different methods. The new forms of the solutions are particularly suitable from the computational point of view when large optical thicknesses are involved. Mathematical expressions corresponding to physical quantities such as directional radiation and total fluxes emerging from a Rayleigh scattering atmosphere are also derived. Author (TAB)

N66-35594# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
RELATIVE ORIENTATION OF THE EARTH'S EQUATOR AND THE LUNAR ORBIT IN THE DISTANT PAST
N. A. Sorokin 5 May 1966 13 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 42, 1965 p 1070–1074
(RSIC-546; AD-634941) CFSTI: HC $1.00/MF $0.50

The variations of the moon–earth distance and the inclination angle of the earth's axis to the plane of the lunar orbit during the tidal evolution of the earth–moon system are discussed. At 'closest approach' the moon was at a distance of 2.4 earth radii. The inclination angle of the earth's axis with the normal to the moon's orbit increased with time. Its minimal value was 12 degrees for the moon–earth distance of 4 earth radii. At 'closest approach' it was 13 degrees. Author (TAB)

N66-35596*# Geological Survey, Washington, D. C.
ASTROGEOLOGIC STUDIES. PART D: STUDIES FOR SPACE FLIGHT PROGRAM Annual Progress Report, Aug. 25, 1962–Jul. 1, 1963
May 1964 141 p refs
(NASA Order R-66)
(NASA-CR-58623) CFSTI: HC $4.00/MF $1.00 CSCL 22A

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5. CHANGE OF EFFECTIVE TARGET STRENGTH WITH INCREASING SIZE OF HYPERVELOCITY IMPACT CRATERS E. D. Heitowit, H. J. Moore (NASA. Ames Res. Center), and D. E. Gault p 52–63 refs (See N66-35601 21-32)

6. PHOTOGRAMMETRIC MAPPING OF EXPERIMENTAL CRATERS R. V. Lugn p 64–70 refs (See N66-35602 21-13)

7. PHOTOGRAPHIC AND PHOTOELECTRIC INVESTIGATIONS OF EARTH-MOON LIBRATION REGIONS L_4 & L_5 FROM MT. CHACALTAYA, BOLIVIA E. C. Morris J. Ring, and H. G. Stephens p 71–74 refs (See N66-35603 21-30)

8. SEMI-MICRO X-RAY FLUORESCENCE ANALYSIS OF TEKTITES USING 50 MILLIGRAM SAMPLES H. J. Rose, Jr., F. Cuttitta, M. K. Carron and R. Brown p 75–84 refs (See N66-35604 21-06)

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N66-35597*# Geological Survey, Washington, D. C.
A PHOTOMETRIC TECHNIQUE FOR MEASUREMENT OF LUNAR SLOPES
D. E. Wilhelms *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 1–12 ref (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00

The use of a single photograph is employed in a photometric technique for determining lunar slopes on the basis of darkening by shadows. A preliminary outline of the method, which was originally applied by van Diggelen in 1951 to low mare ridges, is presented which is usable for all types of terrain and will express results in terms of slope frequency distribution curves and maps of wide areas of lunar terrain. The procedure is outlined, and some sample curves are shown. It is noted that the method lends itself to automation techniques. M.W.R.

N66-35598*# Geological Survey, Washington, D. C.
A LUNAR ISOTONAL MAP
Robert J. Hackman *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 13–28 refs (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00

An isotonal map was prepared by outlining areas of equal density on a photograph of the moon. The Lansberg region of the moon, in the center of the western half of the lunar disk, is illustrated; and densitometer curves are shown for the three transverses across this region. The curves demonstrate that the high-contrast film was exposed so as to enhance tone contrast in the darker parts of the photographs representing the maria. Tone differences in the brighter parts of the photograph, representing highlands and rays, are diminished. The dark tones are shifted from the shoulder of the gamma curve to the straight line portion, and exhibit more contrast; the brighter tones are shifted to the toe of the curve, and exhibit less contrast. The procedure followed is detailed, and it is concluded that such an isotonal map depicts small tone variations, designates brightest and darkest tone regions, and correlates tones with far greater precision than can be done by the eye. Ray material is considered to be more extensive than previously supposed, and tone variations on the lunar maria are said to be unrelated to recognizable topography. M.W.R.

N66-35600*# Geological Survey, Washington, D. C.
DENSITY OF SMALL CRATERS ON THE LUNAR SURFACE
H. J. Moore *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 34–51 refs (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00

Based on the influx of interplanetary debris, a high density of craters up to 10 meters in width is predicted for the lunar surface. It is speculated that 10% of the total lunar surface could be covered by well-preserved craters between 1 and 1[illegible] meters across, 10% by craters between 0.1 and 1 meter, and [illegible] 10% by craters between 0.01 and 0.1 meter. It is noted that extrapolated crater counts are probably invalid on the basis of significant differences between theoretical predictions and extrapolated values. Details are presented for the mass and number of bodies impacting the lunar surface, as well as the density of the secondary-impact craters which may contribute to the surface roughness of the moon. M.W.R.

N66-35603*# Geological Survey, Washington, D. C.
PHOTOGRAPHIC AND PHOTOELECTRIC INVESTIGATIONS OF THE EARTH-MOON LIBRATION REGIONS L_4 AND L_5 FROM MT. CHACALTAYA, BOLIVIA
E. C. Morris, J. Ring, and H. G. Stephens *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 71–74 refs (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00

To determine the possible existence of clouds of dust or particulate matter in the orbital path of the moon, and 60° ahead of and behind the moon, photographic and photoelectric investigations are being made of the L_4 and L_5 libration regions; which are also known as Lagrangian points, or the equilibrium point or the equilibrium points where the centrifugal forces balance the gravitational forces. Raster scans of the sky covering an area of 10° on a side were made in the Lagrange point region by scanning in azimuth and allowing the sky to drift through the field of view. Astronomical calibration was made by scans across the Magellanic clouds and the zodiacal light at several elongations; and absolute calibration was accomplished in the laboratory with a tungsten filament lamp. No dust cloud is found in preliminary reductions of the point scans obtained by averaging the ordinates on the recorder chart for one degree square of sky area. M.W.R.

N66-35605*# Geological Survey, Washington, D. C.
COMPUTER ANALYSIS OF AREAL MICROPHOTOMETER DATA FROM LUNAR PHOTOGRAPHS
A. T. Miesch and C. W. Davis *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 85–115 refs (See N66-35596 21-30) CFSTI: HC $4.00/MF $1.00

Techniques used for the analysis of microphotometric measurements taken on a full-moon photographic plate, as well as some preliminary computations are reported. The large areas of Procellarian mare material and Apenninian regional material were analyzed for variance of polynomial regression surfaces; and it is noted that more detailed microphotometric scanning is necessary for the examination of small areas such as Milichius and Milichius A. A highly generalized flow chart for the computer program being prepared for analysis of such data is shown, and some statistics that are provided by several parts of the program are tabulated. It is concluded that statistical analysis of such data results in information that can be interpreted in terms of known geologic features of the lunar surface; and that full automation will better utilize these techniques. Measures of overall albedo, variations in albedo, textural properties of albedo patterns, and regional degradation in albedo are provided; along with estimates of their statistical significance. M.W.R.

N66-35640# Defence Research Board, Ottawa (Ontario).
THE IRRELEVANCE OF BALDWIN'S RELATIONSHIP FOR DECIDING THE CAUSE OF LUNAR CRATER FORMATION
G. S. Shteinberg Jan. 1966 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 1, 1965 p 55–57
(T-446-R; AD-631659) CFSTI: HC $1.00/MF $0.50

The meteoritic hypothesis of lunar crater formation is examined in light of Baldwin's relationships and volcanic calderas. Various

theories on the volcanic (caldera) genesis for the lunar craters are reviewed. Other explosive volcanic formations morphologically similar to lunar craters and satisfying Baldwin's ratio are briefly mentioned. S.P.

N66-35651*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A DIGITALIZED SOLAR ULTRAVIOLET SPECTRUM
R. T. Brinkmann, A. E. S. Green (Florida Univ.), and C. A. Barth 15 Aug. 1966 84 p refs
(Contract NAS7-100)
(NASA-CR-77556; JPL-TR-32-951) CFSTI: HC $2.50/MF $0.75 CSCL 03B

The solar ultraviolet spectrum obtained in rocket experiments by the Naval Research Laboratory (NRL) is presented in a digitalized form for use in the analysis of upper atmosphere experiments. The data cover the spectral regions between 2990 and 1760 Å and between 1550 and 880 Å. The procedure is described for converting the NRL graphical data into digital form. Above 2085 Å, readings are given every 0.1 Å; below this wavelength, readings are given every 0.2 Å. Both high-resolution and calculated low-resolution spectra are presented. Author

N66-35653*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-39, VOLUME IV FOR THE PERIOD APRIL 1, 1966 to MAY 31, 1966. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
F. M. Sturms, Jr. et al 30 Jun. 1966 288 p refs
(Contract NAS7-100)
(NASA-CR-77673; JPL-SPS-37-39, Vol. IV) CFSTI: HC $3.75/MF $1.75 CSCL 22A

Research and development in various fields of space science and technology are reported. Articles on mission opportunities in the 1970's, satellite observation calculations, and spacecraft motion equations are part of the systems division presentation. Several articles deal with spacecraft power and control and related characteristics of liquid helium and germanium. Thermal testing and properties of ceramics and metals are treated. Developments in liquid and solid propellant engineering, polymer research, and power conversion are reported. Other articles treat infrared spectroscopy, resonant absorption by helium, boundary layer stability, particle interaction, and nuclear spectroscopy. Articles on telecommunications cover data processing systems, spacecraft radio communication, effects of multipactors and solar winds, coding systems, and combinatorial communications. Additional articles are included on estimate optimization and the ray equation in the solar corona. K.W.

N66-35682# Academy of Sciences (USSR), Moscow.
THE OUTER REGION OF THE EARTH'S IONOSPHERE (FROM 2000 TO 200,000 KM)
V. V. Bezrukikh and K. I. Gringauz Repr. from Kosmich. Issled. (Moscow) [1965] p 177-184 refs In RUSSIAN
CFSTI: HC $1.00/MF $0.50

After a review of past and present data available and of methods for determining the composition of the ionosphere, the accomplishments of recent years are discussed. The electron and ion concentrations in inter-planetary environments as determined by the Soviet spacecraft Luna II and the satellite Elektron II are compared with data obtained by U.S. probes aboard IMP-I and Explorer 18. The exploration of the peripheral regions of the ionosphere and the collector equipment of Soviet space probes are described. Considered are also the effects on collected data of such phenomena as ultraviolet solar radiation, high temperature, and atmospheric conditions. Graphs are included which show altitudes reached by probes and electron and ion concentrations and energies. It is pointed out that the study of the peripheral regions of the ionosphere will permit cosmic orientation and navigation by means of ion collector tubes. Transl. by K.W.

N66-35699*# Royal Observatory, Edinburgh (Scotland).
REPORT OF THE ASTRONOMER ROYAL FOR SCOTLAND FOR THE YEAR ENDING 31st MARCH 1966
H. A. Brueck 31 Mar. 1966 24 p refs CFSTI: HC $2.00/MF $0.50 CSCL 03A

Astrophysical, seismological, and space research programs are reported. Among the astronomy programs mentioned are interstellar obscuration, stellar associations and rotation, element abundances, and night sky photometry. Spectrophotometry and photography from ROE-D rockets and ESRO satellites, and satellite tracking programs are described. Seismological field work, instrumentation, and array interpretation are summarized. N.E.N.

N66-35729*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
SOLAR EVOLUTION WITH VARYING G
D. Ezer and A. G. W. Cameron [1965] 50 p refs
(NASA-TM-X-56937) CFSTI: HC $2.00/MF $0.50 CSCL 03B

The model sequence calculations by the writers of early solar evolution have been extended to the case of a varying-G cosmology. In the varying-G sun there is less lithium depletion than in a constant-G sun, and the time required to burn out central hydrogen is decreased by less than the ratio of luminosities owing to the much greater total helium production in the varying-G sun. At the present time the varying-G model has four times the B^8 neutrino flux of the constant-G model, a prediction which can be subjected to an experimental check. Author

N66-35745*# Northrop Corp., Newbury Park, Calif. Ventura Div.
A STUDY ON SENSOR SYSTEMS FOR INITIATING PARACHUTE DEPLOYMENT FOR A MARS ENTRY VEHICLE Final Report
Fred E. Mickey Jun. 1966 116 p refs Prepared for JPL
(Contract NAS7-100; JPL-951174)
(NASA-CR-76473; NVR-4062) CFSTI: HC $3.00/MF $0.75 CSCL 22A

The results of a study, encompassing the analysis of sensor systems suitable for initiating parachute deployment on a Mars entry vehicle, are presented. It is shown that a variety of sensor concepts are feasible in various degrees. Several of these concepts are analyzed, preparatory to selecting two for use as parallel subsystems in a "Final System." The performance of the Final System is analyzed in terms of ten independent variables, and it is found that the largest altitude-uncertainty component is due to the current lack of good definition for the Martian atmosphere. An electrical design for the Final System is presented, and it is shown conclusively that today's technology and hardware can provide a sensor system with sufficient flexibility to assure accurate sensing over the wide range of possible Martian atmospheres, entry conditions and environmental conditions currently postulated for the mission. A reliability analysis, presenting guidelines for additional reliability improvement, is also included as part of the study. Author

N66-35780# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 139
1 Sep. 1966 96 p refs
(JPRS-33397; TT-66-11147-139) CFSTI: $3.00

New items and abstracts of scientific articles which appeared in Sino-Soviet Bloc publications are presented. The research areas covered include astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space. The results of the 10th Antarctica Expedition are reported, and abstracted data are included on the Kamchatka glaciers, and the load carrying capacity of shore ice. M.G.J.

N66-35767*# Alabama Univ., University. Bureau of Engineering Research.
A STUDY OF LUNAR RESOURCES: A PRELIMINARY REPORT OF SURFACE AND SOME OTHER MINING SYSTEMS Summary Report, 22 May 1965–1 May 1966
Reynold Q. Shotts, Robert M. Cox, David M. Grubbs, and H. William Ahrenholz 29 Apr. 1966 89 p refs
(Contract NAS8-20134)
(NASA-CR-77720) CFSTI: HC $3.00/MF $0.75 CSCL 22A

A study which advocates the use of extraterrestrial resources in lunar and planetary exploration projects, is reported. Discussed are: economic limits and time sequences for lunar resource utilization, lunar geology and the occurrence of water, the range of possible mining systems, models possibly suitable for surface mining, environmental problems of surface mining, and special problems in lunar mining. S.C.W.

N66-35794*# Consultants and Designers, Inc., Arlington, Va.
ON THE INTERMEDIATE ORBITS OF THE EARTH'S ARTIFICIAL SATELLITES [O PROMEZHUTOCHNYKH ORBITAKH ISKUSSTVENNYKH SPUTNIKOV ZEMLI]
E. P. Aksenov 25 Aug. 1965 17 p refs Transl. into ENGLISH from Vestnik. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 3, 1965 p 36–44
(Contract NAS5-3760)
(NASA-CR-77674; ST-CM-10374) CFSTI: HC $1.00/MF $0.50 CSCL 22C

This paper provides new forms for the solution of the problem of construction of intermediate orbits, which may be more practical for the calculation of satellite's coordinates and more useful during the indispensable expansion in series of the perturbation function. Author

N66-35795*# Consultants and Designers, Inc., Arlington, Va.
NEW SYSTEM OF ELEMENTS AND TABLES OF MOTION OF JUPITER'S X SATELLITE [NOVAYA SISTEMA ELEMENTOV I TABLITSY DVIZHENIYA X SPUTNIKA YUPITERA]
E. N. Lemekhova 5 May 1966 43 p refs Transl. into ENGLISH from Byul. Inst. Teor. Astron. (USSR), Y. 8, no. 2(95), 1961 p 103–131
(Contract NAS5-9299)
(NASA-CR-77675; ST-SPHA-CM-10483) CFSTI: HC $2.00/MF $0.50 CSCL 03A

Tables have been composed, giving the jovicentric coordinates of the tenth satellite of Jupiter. Determined to that effect were all the solar perturbations that provide the geocentric positions (α,δ) of the satellite within 5". The Delaunay theory of motion of the Moon was applied to the determination of solar perturbations of Jupiter's X satellite. The theoretical values of node's and perijove's secular motions have been computed. A beforehand improvement of the Herget system of elements has been performed on the basis of satellite's observations from 1938 to 1942, taking all these perturbations into consideration. The resulting corrections of elements proved to be rather substantial. The new system of elements represents the observations ten times better than does the Herget system of elements. The tables have been compiled on the basis of this new system of elements. Author

N66-35797*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
SURVEYOR STATION VIEW PERIODS AND TRAJECTORY COORDINATES
R. W. Gillett and J. N. Fisher Aug. 1965 590 p refs Prepared for JPL
(Contract JPL-950056)
(NASA-CR-77659) CFSTI: HC $7.89/MF $3.25 CSCL 22C

Station view periods and trajectory characteristics for Surveyor missions are tabulated. View periods are provided for Deep Space Instrumentation Facility tracking sites located at Ascension Island, Canberra, Australia; Johannesburg, South Africa; Goldstone, California; and Madrid, Spain. Station coordinates and identification numbers are listed, along with pointing restrictions for the view periods. The printout format for each trajectory, defined by a launch date and launch azimuth, is divided into three sections. The first contains the orbit parameters of the transfer-orbit trajectory and includes the initial conditions at transfer-orbit injection. The second contains the view period and tracking information. At the occurrence of either a view period event or a mission event, the tracking parameters of the probe with respect to all stations viewing it at that instant are calculated and printed. The third section tabulates the position and velocity vectors of the probe at the occurrence of mission events. R.N.A.

N66-35803*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CALCULATION OF SMALL ROCKET TRAJECTORIES USING ONLY ROCKET-TO-LAUNCHER RADIAL VELOCITY DATA
J. E. Jackson and S. M. Radicella 15 Aug. 1962 36 p refs
(NASA-TM-X-55548; X-615-62-139) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A method for calculating rocket trajectories using only Doppler data at one receiving site is developed. The method can calculate small rocket trajectories above the drag region (Z greater than 70 km) with an accuracy of about 1 km, and only requires a few simple operations on a desk calculator. The calculations are based on a measurement at the launching site of the rocket radial velocity $\dot{R}$ versus time using Doppler data at 73.6 Mc. Although the method is applicable to any small rocket trajectory with a peak altitude less than 200 km, this presentation is based on Nike-Cajun trajectories. R.N.A.

N66-35854# Sydney Univ. (Australia). School of Physics.
LABORATORY SIMULATION OF MAGNETIC FIELDS PRODUCED IN THE MOON BY THE TRAPPED FIELD OF THE SOLAR PLASMA STREAM
I. G. Brown, T. Gold, and C. N. Watson-Munro Jan. 1966 6 p refs
(ER-18; NP-15939)

The magnetic field of a laboratory moon in a plasma stream was investigated. A stainless steel moon of 2 cm radius was located in a rotating ionizing plasma shock wave. The results are discussed. NSA

N66-35959*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Geo-Astrophysics Section.
POLARIMETRIC MEASUREMENTS OF SIMULATED LUNAR SURFACES Third Interim Report
W. G. Egan and L. L. Smith Mar. 1966 75 p refs
(Contract NAS9-4942)
(NASA-CR-77764; RM-315) CFSTI: HC $2.50/MF $0.75 CSCL 03B

Progress is reported in blue (0.48μ), green (0.54μ), visual (0.54μ), and infrared (1.0μ) polarimetric measurements of simulated lunar surfaces. Emphasis is placed on previously derived polarimetric models which were modified by sprinkling with powders of volcanic ash, coral, furnace slag, and copper oxide. It was found that volcanic ash topped with particles of itself gives the closest match of the lunar surface. The major conclusion is that the polarization properties of the lunar surface can be produced by a suitable particulate coating of the underlying material. This will ultimately give information as to the choice of good landing areas for the Apollo mission. C.T.C.

N66-36037*# Geological Survey, Flagstaff, Ariz.
EXAMINATION OF THE LUNAR NEAR-SURFACE ROCKS BY ENGINEERING SEISMIC TECHNIQUES DURING EARLY APOLLO LANDINGS
Joel S. Watkins, Jean Cl. De Bremaecker (Rice Univ.), and Martin F. Kane *In its* Invest of in situ Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. 1965 13 p (See N66-35966 21-13) CFSTI: HC $3.25/MF $1.25

An experiment is proposed to measure the propagation velocity of compressional seismic energy, seismic energy attenuation, energy frequency, spectra, and the velocity of seismic shear waves in rock formations within 20 m of the lunar surface. The instrument system, which weighs less than 4.5 kg and operates on less than 20 watts of power, basically consists of 3 transistorized amplifiers, a 4-channel tape recorder, 3 miniature detectors, and a low-energy shooting device. Resultant data will be evaluated in terms of thickness of the fragmental layer of rocks on the lunar surface, degree of induration and bearing strength of the near-surface materials, and possibly the in situ elastic constants of the materials. Velocity, amplitude, attenuation, and shooting efficiency data for this proposal were collected by an in situ seismic field crew at sites reconnoitered, mapped, and cored by an in situ geologic field crew. K.W.

N66-36023# Kapteyn Astronomical Lab., Groningen (Netherlands).
VARIABLE STARS IN A FIELD CENTRED AT $l^{II}=0°$, $b^{II}=+29°$ (FIELD 1 OF THE PALOMAR–GRONINGEN VARIABLE-STAR SURVEY)
L. Plaut Jun. 1966 82 p refs *Its* Bull. of the Astron. Inst. of the Netherlands, Suppl. Ser., Vol. 1, No. 3 CFSTI: HC $3.00/MF $0.75

This paper gives the first results of a variable-star survey. It considers the variable stars in field 1 centred at $l^{II}=0°$, $b^{II}=+29°$. The first three sections describe the program, the observations and the discovery of the variables. Section 4 is an extended treatment of the completeness of the discoveries, a problem important for the derivation of spatial density. The five following sections are devoted to the methods of reducing the observations. The remaining sections give the results. These concern 51 RR Lyrae stars, 17 long-period, semi-regular and irregular variables, one star probably belonging to the U Geminorum type, and 8 eclipsing variables. The spatial density of RR Lyrae variables is derived in section 12. The result is shown in figure 9. There is good agreement with the recent results by Kinman, Wirtanen and Janes (1965) for a field close to field 1. The small numbers of stars of other types do not allow a similar discussion. Author

N66-36035# Massachusetts Inst. of Tech., Cambridge.
OPTIMAL CO-ALTITUDE RENDEZVOUS WITH CONSTANT THRUST ACCELERATION
Paul G. Kaminski (M.S. Thesis) Jun. 1966 83 p refs
(Contract AF 33(608)-1249)
(AD-635245) CFSTI: HC $6.00/MF $0.75

A family of minimum time rendezvous trajectories is presented for a pursuer and target initially in the same circular orbit but separated by the central angle beta null. The thrust acceleration of the pursuer is constrained to a constant magnitude so that the control variable is the thrust angle. With this constraint, minimum time and minimum fuel solutions are identical. Solutions are presented for two cases, the first involving a near-optimal thrust angle program generated using a set of linearized adjoint equations, and the second involving the optimal program generated with the true adjoint equations. In each case the form of the thrust angle program is developed in terms of four constants which are chosen to solve the two-point boundary value problem associated with rendezvous. These constants are determined by iteration using the Newton-Raphson method. Author (TAB)

N66-36047*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
POLARIMETRIC MEASUREMENTS OF SIMULATED LUNAR SURFACES (PHASE II) Second Interim Report
W. G. Egan and L. L. Smith Feb. 1966 73 p refs
(Contract NAS9-4942)
(NASA-CR-77767; RM-312) CFSTI: HC $3.00/MF $0.75 CSCL 03B

The polarization properties of volcanic ash and furnace slag (simulated lunar surface) materials were investigated as a function of particle size, albedo, and porosity. The test specimens used, preparation of test samples, experiments performed, plane of polarization observations, results, and implications for lunar studies are discussed. Results indicate that the range of particle sizes on the lunar surface would have to exist either as a contiguous volume or as a simple, thin layer of the order of up to 1 mm thickness. This model is consistent with the Luna 9 observations, and also with thermophysical and photometric models. The observations were made under terrestrial conditions and the high vacuum conditions on the moon plus the effect of solar wind proton bombardment could possibly alter the results. It appears that the polarization-albedo-porosity relationship for particles below 0.5 mm in size may be used to advantage in elucidating the mechanical properties as well as the thermal properties of a lunar surface model. Curves of the polarimetric data obtained are given, along with photographs of the materials studied. L.S.

N66-36050*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SATELLITE ORBITAL TRANSFER STUDIES Final Report, 29 Jun. 1965–30 Aug. 1966
Gary A. Mc Cue and David F. Bender 16 Aug. 1966 115 p refs
(Contract NAS8-20238)
(NASA-CR-77878; SID-66-1224) CFSTI: HC $4.00/MF $1.00 CSCL 22C

Quasilinearization was used to solve two orbital transfer problems. The first involves a discontinuous two-point boundary value problem which resulted from a variational formulation concerning optimal orbital transfer. The boundary conditions were such that the transfer trajectory's end points could be assumed to be at unspecified positions upon arbitrary coplanar orbits. The quasilinearization technique was used to determine trajectories that minimized the fuel required for orbital transfer maneuvers accomplished in a fixed time interval. The second problem concerned finding impulsive transfers in the general three-body problem. A computer program was developed by using the quasilinearization technique to solve the two-point boundary value problem that occurs. The specified boundary conditions were the departure and arrival points. The problem was to find the impulses required to complete the transfer. The required initial estimate of the trajectory was produced by a patched conic trajectory program, but may also be supplied in as many as ten linear segments. L.S.

N66-36074*# Florida State Univ., Tallahassee. Dept. of Physics.
A STUDY OF MILLISECOND PULSES CONTAINED IN THE DECAMETRIC RADIO RADIATION FROM JUPITER
Richard Thomas Lee (M. S. thesis) Aug. 1966 56 p refs
(Grant NsG-224-61)
(NASA-CR-77980) CFSTI: HC $3.00/MF $0.50 CSCL 03A

Observations have been made of the left- and right-handed components of the pulses, which have arbitrarily been called I-pulses, at 16, 18 and 22 Mc/s and of the total power at 14 and 26 Mc/s. A minimum time resolution of 7 msec was obtained with an eight-channel, electric writing, high speed recorder system. In addition to the criteria usually accepted for identification of Jovian radiation, polarization and bandwidth have been used to discriminate the I-pulses from static pulses. The I-pulses have been observed to have durations as short as or shorter than 10

msec with different forms of grouping during an event. The I-pulses were found to be correlated with System III longitude on Jupiter, being more closely associated with "sources" B and C than to "source" A. The null region D was also shown. The I-pulses were narrow banded and polarized in much the same way as normal Jovian radiation. Selected events showed similar axial ratio distributions. Author

N66-36077*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SATELLITE ORBITAL DATA

Beatrice Miller 4 Apr. 1966 102 p

Grant NsG-87-60)

(NASA-CR-77761; SAO Special Rept.-208) CFSTI: HC $4.00/MF $0.75 CSCL 22C

Orbital data tables are presented for several satellites including Explorer 1, 8, 9, and 19, Vanguard 2, and 3, Echo 1 and 2, Telestar 1 and 2, Anna 1B, Injun 3, Relay 1, and Saturn 5. The mean and smooth elements shown are derived mainly from data obtained by field reduced photographic observations. Mean element values such as argument of perigee, right ascension of the ascending node, inclination, eccentricity, and mean anomaly are given as functions of time expressed in days. Smoothed elements are also given as functions of time and generally include both secular and periodic terms. A.G.O.

N66-36080*# Naval Research Lab., Washington, D. C. E. O. Hulburt Center for Space Research.

RECENT EXTREME ULTRAVIOLET SOLAR SPECTRA AND SPECTROHELIGRAMS

W. E. Austin, J. D. Purcell, C. B. Snider, R. Tousey, and K. G. Widing [1966] 20 p refs Presented at the COSPAR Meeting, Vienna, 10–19 May 1966 Submitted for Publication

(NASA Order R-104)

(NASA-CR-77752) CFSTI: HC $1.00/MF $0.50 CSCL 03A

Extreme ultraviolet spectroheliograms obtained on October 20, 1965, February 1, 1966, and with 10" spatial resolution on April 28, 1966, show that the chromospheric coarse mottling and network are characteristic of He II 304 Å; high chromospheric lines such as Mg IX 368 Å are emitted mostly from the limb and plages; coronal lines like those from Fe XV and XVI come only from plages and the corona above them. Spectra obtained on February 1, 1966 show that Fe XV 284 Å and Fe XVI 335, 361 Å are of low intensity in the quiet sun, by comparison to September 20, 1963 when the sun was active. In the new spectrum all three lines of Fe XIV $3p\ ^2p^0$–$3d\ ^2D$ are resolved, but the identification of Fe XIV $3s\ ^2p^0$–$3p\ ^2P$ remains questionable. The range 70–105 Å was photographed using a filter of indium instead of aluminum. Many new lines are present, including lines of Fe IX, X, and XI. Author

N66-36082*# Naval Research Lab., Washington, D. C. E. O. Hulbert Center for Space Research.

USE OF THE MOON TO DISTINGUISH THE F FROM THE K CORONA USING A ROCKET CORONAGRAPH DURING AN ECLIPSE

R. Towsey, M. J. Koomen, R. E. Mc Cullough, and R. T. Seal, Jr. [1965] 23 p refs Presented at the NASA Eclipse Symp., Ames Res. Center, Moffett Field, Calif., 17 Dec. 1965 Submitted for Publication

(NASA Order R-107)

(NASA-CR-77754) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The observation of the outer corona by lifting a coronagraph to a position above the Rayleigh sky in rockets, orbiting vehicles, and stratospheric balloons is discussed. A photograph of the coronagraph instrumentation is shown, and the components are described. Results from a flight when the moon was not in the coronagraph field, taken at altitudes between 130 and 204 km, are reported, and it is pointed out that the photographs showed a single coronal streamer. The nature of a coronagraph experiment conducted during a solar eclipse is presented by a figure which combines a schematic diagram of the shadowing produced by the moon together with an estimated curve showing the brightness of the corona and the moon's shadow as a function of angular distance from the sun's center. An experiment of a similar type which might be carried out during an eclipse from an aircraft is also suggested. A.G.O.

N66-36084*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SATELLITE ORBITAL DATA

Beatrice Miller 5 Apr. 1966 101 p

(NASA-CR-77758; SAO Special Rept.-209) CFSTI: HC $4.00/MF $0.50 CSCL 22C

Mean and smooth orbital elements, derived from data obtained mainly by field reduced photographic observations, are presented for various satellites. As opposed to osculating elements, the elements shown here are mean in the sense that the effects of the short period perturbations due to the earth's oblateness have been eliminated. The tabulated mean element values, argument of perigee, right ascension of the ascending node, inclination, eccentricity, and mean anomaly, are given as functions of time expressed in days. Smoothed elements, which have been derived from observations covering about two weeks or more, are also given as functions of time and generally include both secular and periodic terms. A.G.O.

N66-36130*# National Aeronautics and Space Administration, Washington, D. C.

PLANETARY ATMOSPHERES—A CONTINUING BIBLIOGRAPHY, FEBRUARY—MAY 1966

Aug. 1966 135 p refs With Indexes

(NASA-SP-7017(01)) CFSTI: HC $1.50/MF $1.00 CSCL 03B

A continuing annotated bibliography, together with personal author and subject indices, on planetary atmospheres is presented. Most of the entries pertain to investigations of Mars and Venus, many of which are the result of the successful probes of the atmospheres of Venus by Mariner II and Mars by Mariner IV. A limited number of references to the atmospheres of Jupiter, Mercury, and Saturn is also included. References to such specific topics as the theory of planetary origins, extraterrestrial environment, planetary exploration and spacecraft entry, and the physical properties of the planets are provided. Pertinent references to the techniques of planetary observation and measurement, e.g., those involving photography, photometry, spectroscopy, astronomy, and meteorology, are also given. R.N.A.

N66-36243# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

PROBLEMS IN THE MOTION OF ARTIFICIAL CELESTIAL BODIES [PROBLEMY DVIZHENIYA ISKUSSTVENNYKH NEBESNYKH TEL]

May 1964 202 p refs Transl. into ENGLISH of the Reports at the Conf. on Gen. and Appl. Probl. of Theoret. Astronomy, Moscow, 20–25 Nov. 1961

(ACIC-TC-818, Vol. II; TT-65-64304; AD-623452) CFSTI: HC $6.00/MF $1.25

Various conference reports on general problems of theoretical astronomy dealing with celestial body motion are presented. Areas discussed include numerical methods for estimating errors in numerical integration of equations of celestial mechanics. Papers dealing with the accuracy of ephemeris of inner planets and the utilization of electronic computers for constructing theories of motion. Methods of orbit determination from measurements of the Doppler effect are included. Problems of translational-rotary motion

and gravitational attraction of celestial bodies are enumerated, and motion equations for artificial earth satellites are derived. Other areas investigated are perturbations in the forward-rotating motion of celestial bodies and the power function of attraction of a planet and its satellite. S.P.

N66-36263*# Consultants and Designers, Inc., Arlington, Va.
FREQUENCY SPECTRA OF THE SOURCES 3C 295 AND 3C 380 [CHASTOTNYYE SPEKTRY ISTOCHNIKOV 3C 295 I 3C 380
L. L. Bazelyan, S. Ya. Braude, and A. V. Men' 14 Apr. 1966 8 p refs Transl. into ENGLISH from Astron. Tsirkuliar Akad. Nauk SSSR (Karzan), no. 357, 25 Feb. 1966 p 5–7 Presented at the All-Union Conf. on Radioastronomy, Kharkov, 1965
(Contract NAS5-9299)
(NASA-CR-77886; ST-IGA-10476) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The measurements of flux densities of the sources 3C 380 and 3C 295 were made on the basis of the method described during the first half of 1965, and utilizing the same wideband interferometer, in the frequencies of 20–40 Mc. Author

N66-36303*# TRW Systems, Redondo Beach, Calif.
COORDINATE SYSTEMS FOR DIFFERENTIAL CORRECTION
E. A. Emerson and W. W. Lemmon Washington, NASA, Sep. 1966 36 p refs
(Contract NAS1-4605-3)
(NASA-CR-604) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A system of state transition partial derivatives is presented for the case in which the tracking information normal matrix for a lunar orbiter is nearly diagonalized. This result was obtained by using a set of regression variables which, for an earth-centered tracker and assuming circular orbits for moon and satellite, precisely diagonalize the normal matrix. An analytic estimate of the correlations between the variables (for typical tracking data rates over one revolution of the moon about the earth) indicated that their maximum correlation approaches $\sqrt{2/3}$ as the limiting case. The analytical results were demonstrated in a simulated tracking study. This report does not present the theoretical basis for these partial derivatives, nor the method of their derivation. Author

N66-36319*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FINITE-THRUST ESCAPE FROM AND CAPTURE INTO CIRCULAR AND ELLIPTIC ORBITS
Edward A. Willis, Jr. Washington, NASA, Sep. 1966 65 p refs
(121-30-02-01-22)
(NASA-TN-D-3606) CFSTI: HC $2.50/MF $0.75 CSCL 22C

Finite-thrust escape and capture trajectories are considered which lead from a circular or elliptic orbit to a specified hyperbolic excess velocity vector located at the gravitational "sphere of influence." Each trajectory consists of a powered maneuver initiated at the parking orbit and a coasting arc from the cutoff point to the sphere of influence. The powered maneuver is accomplished with constant, continuous thrust and constant jet velocity. Tangential steering and optimum thrust-initiation points are used to obtain very nearly minimum characteristic velocity increments. These near-optimal finite-thrust trajectories are analyzed in dimensionless terms and compared with equivalent impulsive ones. The minimal characteristic velocity ratio, the optimum characteristic central angle, and the optimum initial true anomaly for departing from an elliptic orbit are found for a wide range of planetocentric trajectories. The results are presented as functions of the dimensionless hyperbolic velocity, acceleration, and jet velocity parameters. The results may be conveniently used in combination with ballistic interplanetary trajectory calculations to obtain a realistic geometric description and accurate propellant fractions for a great variety of interesting and potentially important space flight missions. Examples illustrating the use of these data for actual mission problems are also presented. Author

N66-36325*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TRAJECTORY OPTIMIZATION BY EXPLICIT NUMERICAL METHODS
Lyle R. Dickey 25 May 1966 29 p refs
(NASA-TM-X-53464) CFSTI: HC $2.00/MF $0.50 CSCL 22C

The problem of trajectory optimization is considered from the standpoint of numerical analysis. A numerical solution is obtained for an assumed thrust angle history, and an explicit numerical solution is obtained for the linearized equations of motion for neighboring solutions. With the explicit solution available, it is not difficult to determine whether or not the assumed solution is optimum. The first and second variations together provide a straightforward iteration method of approaching the optimum solution. It is of particular interest that the procedure remains unaltered even by the introduction of discontinuities and intermediate constraints. Author

N66-36328*# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
SATELLITE GRAVITY-GRADIENT APPLICATIONS FOR GEODETIC DETERMINATIONS
Armando Mancini and Robert A. Schow, Jr. *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 13–18 (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The problems of the geodesist in determining Earth shape and size are solved through the accumulation of a variety of observations including measurements on the Earth's surface and satellite tracking data. These observations must be carefully integrated in reduction to obtain the best fitting figure of the Earth. Gravity-gradient-stabilized satellites could enhance geodetic determinations by providing additional observations. Similar contributions could be made to lunar mapping and selenodesy. Primary limitations in application lie in the complex engineering problems involved in providing appropriate instrumentation. Author

N66-36357# National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
May 1966 50 p
(RRC-A130, Pt. 2; SG-3) CFSTI: HC $2.00/MF $0.50

A compilation of solar and geophysical data gathered by the Radio Propagation Unit of India's National Physical Laboratory is presented. The participating stations and organizations are listed along with data on solar indices, solar flares, solar radio emission, solar flare effects, magnetic storms, ionospheric effects of solar flares, and diagrams of SIDs. R.N.A.

N66-36369# National Physical Lab., New Delhi (India). Radio Propagation Unit
SOLAR AND GEOPHYSICAL DATA, PART 2
Jun. 1966 25 p
(RRC-A131, Pt. 2) CFSTI: HC $1.00/MF $0.50

Tables of geophysical and solar data observed by stations in India during April, 1966, are presented. Data are given on solar flare, sunspot number, solar radio emission, and magnetic storm observations; and of solar flare effects on the ionosphere. A list of participating stations and organizations is given. L.S.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-35656*# National Aeronautics and Space Administration, Washington, D. C.
COMMUNICATIONS SATELLITES
Washington, GPO [1966] 22 p
(EP-40) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Historical background, purpose, and problems and their solutions are briefly presented. The function of active and passive satellites is outlined, and characteristics are given of Echo and II, Telstar, Relay, and Project Syncom. The role of satellites in television transmission and in commercial application is discussed. Technical questions are considered, and future technical developments in general, and the ATS Project in specific, are covered. K.W.

N66-35665*# National Aeronautics and Space Administration, Washington, D. C.
SECOND SURVEYOR LAUNCH SET SEPTEMBER 20
14 Sep. 1966 52 p
(NASA News Release-65-29) Available from the Scientific and Technical Information Division CSCL 22B

Presented is NASA information in connection with the launching of the Surveyor B spacecraft. Background of the Surveyor program is discussed. Frame and thermal control, power subsystem, telecommunications, propulsion, flight control subsystem, television, and engineering instrumentation are explained. The Atlas–Centaur launch vehicle is described, and flight sequence, trajectory, tracking, and communication are summarized. Atlas, Centaur, and Surveyor phases are outlined in a discussion of the over-all flight plan. Also described are midcourse maneuvers, terminal sequence, and post-landing events. Illustrations of major components are included. K.W.

N66-35760# Joint Publications Research Service, Washington, D. C.
SUPERIOR TECHNICAL FEATURES OF THE SOVIET SPACE VEHICLE "VOSKHOD"
N. Kamanin 26 Aug. 1966 11 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 27 Oct. 1965 p 2–3
(JPRS-37257; TT-66-33686) CFSTI: $1.00

The technical improvements incorporated into each of the six Vostok spacecraft are reviewed as background data for the development of the three-seater Voskhod. A narrative account is presented on the special features of this spacecraft. These are identified as a ship orientation system using ion direction plotters for directing the ship-s acceleration vector; improved vision conditions; television system for crew observations of surrounding space from the instrument compartment and engine braking sides; soft landing capability; and higher degree of reliability. M.G.J.

N66-35793*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 6, NO. 14
31 Jul. 1966 27 p
(NASA-TM-X-57858; X-512-66-51) CFSTI: HC $2.00/MF $0.50 CSCL 22C

Tables are presented which list all objects presently in earth orbit and objects which have decayed from 1958 through July of 1966. R.N.A.

N66-35847*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 PROJECT REPORT: MISSION OPERATIONS
15 Jun. 1966 201 p refs
(Contract NAS7-100)
(NASA-CR-77794; JPL-TR-32-881) CFSTI: HC $3.75/MF $1.25 CSCL 22A

A description is given of the various operations of the Mariner IV project during the flight from the time of midcourse maneuver to the end of the mission. An account of the trajectory and orbit determination analyses is presented, and the space flight operations system is described. Included are a summary of the post-launch testing results, and a brief account of the final configuration and disposition of the MC-4 and PTM spacecraft at the end of the mission. C.T.C.

N66-35848*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR I MISSION REPORT. PART I: MISSION DESCRIPTION AND PERFORMANCE
Robert J. Parks 31 Aug. 1966 193 p refs
(Contract NAS7-100)
(NASA-CR-77795; JPL-TR-32-1023) CFSTI: HC $3.25/MF $1.25 CSCL 22A

A technical description and an evaluation of engineering results are presented of the systems utilized in the Surveyor I mission. The overall objectives of the project were accomplished, and included (1) a successful soft landing on the moon as demonstrated by operations of the spacecraft subsequent to landing, (2) generation of basic data in support of Appollo, and (3) operations on the lunar surface which will contribute scientific knowledge about the moon and provide further information in support of Apollo. Major areas covered include the space vehicle preparations and launch operations, launch vehicle system, surveyor spacecraft, tracking and data acquisition system, and mission operations system. C.T.C.

N66-36095* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE LUNAR–SOLAR EFFECT ON THE ORBITAL LIFETIMES OF ARTIFICIAL SATELLITES WITH HIGHLY ECCENTRIC ORBITS
Barbara E. Shute and Janice Chiville [1965] 18 p refs Submitted for Publication
(NASA-TM-X-57038) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Estimates of the lifetimes of selected artificial earth satellites have been obtained by considering the influence of solar–lunar perturbations on perigee height. In the sample of satellites with highly eccentric orbits considered, lifetimes were found to be between 2 and 16 years. The very eccentric orbits may have perigee declines that are so rapid that it will be possible to predict in advance the location and time of satellite destruction with enough precision to enable stationing observers in advance. Author

N66-36246*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
RE-ENTRY AND RECOVERY OF FRAGMENTS OF SATELLITE 1960 E1
Charles A. Lundquist, Richard C. Vanderburgh, Walter A. Munn, David Tilles, Edward L. Fireman et al 21 Dec. 1962 21 p refs
(Grant NsG-87-60)
(NASA-CR-77716; SAO Special Rept.-109) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The following topics are dicussed: (1) *Recovery, and Scientific Utilization of Satellite Fragments*—observation of re-entry, recovery of fragments, and scientific investigation of Sputnik IV structural material composition; (2) *Sputnik IV Re-entry:*

The Role of Moonwatch—team organization, and various personnel observations of Sputnik IV re-entry aspects; *(3) Field Investigation of Sputnik IV Sightings and Fragments Recoveries*—interviews of Wisconsin residents who observed satellite re-entry, and the recovery of numerous satellite fragments; and (4) *Radioactivities in the Manitowoc Fragments:*—radioactivity measurements on the shell fragments from Sputnik IV reentry breakup dated the 1960 satellite. G.G.

N66-36306*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER-MARS SCIENCE SUBSYSTEM
Frank L. Schutz et al 15 Aug. 1966 105 p ref
(Contract NAS7-100)
(NASA-CR-77906; JPL-TR-32-813) CFSTI: HC $3.00/MF $0.75 CSCL 22B

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N66-36307*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MARINER-MARS SCIENCE SUBSYSTEM
Frank L. Schutz *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 1–10 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

The Mariner–Mars 1964 mission and spacecraft are briefly described. The primary mission objective was identified as conducting scientific observations of Mars during opposition and transmitting the results to Earth. The trajectory characteristics are outlined. The individual events of the mission profile between launch and mission termination are reviewed. The space flight operations and deep space instrumentation facilities are mentioned. The spacecraft and its subsystems are also described. N.E.N.

N66-36308*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENCE SUBSYSTEM
W. G. Fawcett *In its* Mariner-Mars Sci. Subsystem 15 Aug. 1966 p 11–18 (See N66-36306 21-31) CFSTI: HC $3.00/MF $0.75

Details are presented on the instrumentation of the science subsystem of the Mariner–Mars 1964 mission. The more important characteristics and the corresponding principal investigators are summarized for (1) the instruments, including cosmic dust detector, helium magnetometer, plasma probe, cosmic ray telescope, trapped radiation detectors, ion chamber, and television, and (2) the ancillaries, including data automation system, planetary scan system, and narrow-angle Mars gate. The preassembly and operation are mentioned. One of the most important functions was considered to be the arrangement of the data into a coherent form for transmission by the telemetry system, and the data format is described. N.E.N.

N66-36326*# National Aeronautics and Space Administration, Washington, D. C.
SYMPOSIUM ON PASSIVE GRAVITY-GRADIENT STABILIZATION
1966 291 p refs Symp. held at Ames Res. Center, Moffett Field, Calif., 10–11 May 1965
(NASA-SP-107) GPO: HC $1.75; CFSTI: MF $0.75

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17. SYSTEM PERFORMANCE AND ATTITUDE SENSING OF THREE GRAVITY-GRADIENT-STABILIZED SATELLITES R. T. Beal, P. H. Cudmore, R. H. Kronke, and P. G. Wilhelm (NRL) p 253–269 (See N66-36342 21-31)

N66-36327*# National Weather Satellite Center, Washington, D.C.

STABILIZATION REQUIREMENTS FOR OPERATIONAL METEOROLOGICAL SATELLITES

Edward G. Albert *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 1–11 refs (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The operational meteorological satellite (OMS) mission is to obtain meteorological data on a global basis. The imminent TOS system will use spin-stabilized, Tiros-type satellites to obtain photographic observations with stabilization accuracies on the order of 1°. Stabilization requirements for later observing platforms will be controlled by sensor characteristics. Since an OMS requirement is to optimize the system cost-to-benefit ratio, absolute specification of future stabilization accuracy cannot now be made. In many cases spacecraft sophistication and cost may be balanced against ground-based data-processing capability. For instance, if wide-angle pictures contain adequate horizon images and overlap, picture orientation may be determined to within a few tenths of a degree from the picture data alone. The range of potential stabilization requirements is wide. An omnidirectional radiometer requires no stabilization. A wide-angle camera must be pointed within perhaps, 5° of a nominal direction for efficient use. A line-scan type of sensor requires close three-axis control of position and of correction rates. Author

N66-36329*# National Aeronautics and Space Administration, Washington, D. C.

STABILIZATION REQUIREMENTS FOR COMMUNICATION AND NAVIGATION SATELLITES

A. M. Greg Andrus *In its* Symp. on Passive Gravity-Gradient Stabilization 1966 p 19–32 (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The need for communications satellites developed as a result of increasing world requirements for long-distance real-time communications. The paper summarizes the evolution of long-distance communications, including submarine cables, Moon-bounce techniques, and Courier, Score, Echo I and II, Relay, Telstar, and Syncom satellites, and discusses, in particular, the gravity-gradient efforts that the NASA Communication and Navigation Programs Division is pursuing as part of the Applications Technology Satellite (ATS) flight project. Some applications of active and passive stabilization systems to future mission possibilities, such as direct voice and television broadcast, navigation traffic control, and orbiting relay satellites for deep-space communications and navigation, are discussed. Author

N66-36330*# Goodyear Aerospace Corp., Akron, Ohio.

RICE/WILBERFORCE GRAVITY-GRADIENT DAMPING SYSTEM

A. C. Buxton, D. E. Cambell, and K. Losch *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 35–54 refs (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The concept and performance of the Rice/Wilberforce (R/W) gravity-gradient damper as applied to the NASA Langley Research Center lenticular communication satellite are discussed. This damper is somewhat similar to the lossy hysteresis spring damper but has a very essential difference. The R/W damper is a viscous-fluid or other equivalent rate-sensitive damper which exploits resonant rises and cross coupling in a helical spring between the plunging and torsional modes. It achieves thereby a high articulation gain which converts the low angular rates of gravity-gradient librations into relatively high angular rates of rotation in the viscous damper. The viscous drag coefficient, spring constants, masses, and inertias of the damper are selected and tuned to dissipate maximum energy at discrete satellite libration frequencies, such as the fundamental or second harmonic in pitch and roll. Thus, the usual limitation in the performance of rate-sensitive damping devices in gravity-gradient systems is removed. Damping about all three axes of satellite motion is provided. Author

N66-36331*# General Electric Co., Philadelphia, Pa.

SYSTEMS ANALYSIS AND DESIGN OF A CLASS OF GRAVITY-GRADIENT SATELLITES UTILIZING VISCOUS COUPLING BETWEEN EARTH'S MAGNETIC AND GRAVITY FIELDS

R. J. Katucki and R. G. Moyer *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 55–72 refs (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The paper discusses the systems analysis and design constraints of a uniquely simple, gravity-gradient, attitude-control system having the generic nomenclature GEMAGS (General Electric Magnetically Anchored Gravity System). This class of system has been flight-tested and is the second of the types flight-tested. The initial flight demonstration was a low-altitude (500 n. mi.) one and was limited to two-axis orientation. A subsequent vehicle configured for three-axis stabilization and a second two-axis vehicle have recently been tested in orbit. The basic concept centers around a unique damper element which couples the Earth's magnetic field to the gravity field through a viscous shear medium. Design constraints and application to synchronous altitude are discussed for a wide range of satellite weights and sizes as well as specific applications such as the use with a lenticular passive communication satellite. Weight, accuracy, and damping time tradeoff curves are presented along with discussions of general theory of selection of inertia levels and ratios. A brief description of analytical tools, such as the large-scale, large-angle digital simulation, is also given. Author

N66-36332*# Philco Corp., Palo Alto, Calif. WDL Div.

CONFIGURATION SELECTION FOR PASSIVE GRAVITY-GRADIENT SATELLITES

H. Hartbaum, W. Hooker, I. Leliakov, and G. Margulies *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 73–104 refs (See N66-36326 21-30) GPO: HC $1.75; CFSTI: MF $1.75

The methods and interrelated aspects of the analysis, computer simulation, and final evaluation process necessary for the selection of optimal configurations from among the various hinged gravity-gradient satellites are given in the present paper. The criteria employed are directed toward the attainment of operationally optimum dynamic performance for satisfying particular mission requirements. Two areas are discussed in the paper: Methods of configuration selection and results of configuration studies, both

of which are centered around a specific illustrative example. The first part presents a brief survey of linear analysis and synthesis methods used for system parameter selection. In the second part the performance of near-optimal configurations obtained in the above manner is reevaluated by full nonlinear digital simulation. Specific computer-simulation examples are shown in order to indicate the range of applicability of linear synthesis within the general nonlinear character of the problem. The dominance of nonlinear effects outside this range is illustrated by computer simulations showing tumbling, capture, and attitude reversal, both with and without gimbal stops and with various hinge gimbaling arrangements. Author

N66-36333*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

STUDY OF GRAVITY-GRADIENT EXPERIMENT OF APPLICATIONS TECHNOLOGY SATELLITE

Benjamin G. Zimmerman *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 105–114 refs (See N66-36326 21–31) GPO: HC $1.75; CFSTI: MF $1.75

The gravity-gradient experiment associated with the Applications Technology Satellite (ATS) program uses inertial coupling to permit the damping of all satellite librations by a single auxiliary body having a single degree of freedom with respect to the primary body. A linearized analysis demonstrated that this technique gives good small-angle performance, and preliminary values of system parameters were selected on the basis of this study. This paper reviews studies made with a large-angle mathematical model of the ATS gravity-gradient configuration. The mathematical model permits the choice of linear or hysteresis damping and includes the effects of noncoincidence of the satellite center of pressure and center of the gravity-gradient booms. The in-flight experiments simulated include modification of system moments of inertia by changing the angle between the gravity-gradient booms and introduction of a controlled sinusoidal disturbance torque by a momentum wheel. Author

N66-36334*# TRW Systems, Redondo Beach, Calif.

TWO-DAMPER PASSIVE GRAVITY-GRADIENT STABILIZATION SYSTEM

A. E. Sabroff *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 115–132 refs (See N66-36326 21–31) GPO: HC $1.75; CFSTI: MF $1.75

A design study of a symmetrical, vertistat, passive gavity-gradient stabilization system suitable for communication satellite application is presented. The design employs two damping bodies connected to the main satellite structure through magnetic hysteresis dampers. The suspension point of the three bodies in their nominal common center of mass. Each damping body possesses a single degree of angular freedom relative to the main satellite and the damping body motions lie in orthogonal planes. The gradient optimization study utilized to select this design from classes of boom-damper systems is described. Preliminary parametric tradeoff studies are presented to establish the relationships between ultimate pointing accuracy and both small-angle and large-angle transient responses. Analytic modeling of the hysteresis damper is presented and the orbital disturbance model, including thermal bending of the extendible rods, is developed. The generalized digital simulation utilized for system evaluation is described. Both ultimate pointing accuracy and transient response from initial tumbling are evaluated, the latter in the presence of angular position limits on the allowable relative motion between a damping body and the main satellite structure. Author

N66-36335*# TRW Systems, Redondo Beach, Calif.

MAGNETIC HYSTERESIS DAMPING FOR GRAVITY-GRADIENT STABILIZATION

G. S. Reiter, J. P. O'Neill, and J. R. Alper *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 135–143 refs (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

One form of damping mechanism for gravity-gradient stabilization is a flexural joint incorporating magnetic hysteresis damping. This system develops its maximum damping torque after a small angular rotation. The magnitude of the damping torque does not depend on the rate of rotation; the low angular rates characteristic of the gravity-gradient application make this a highly desirable feature. A magnetic hysteresis damping mechanism satisfying the damping and suspension requirements for typical applications can be provided in a small, lightweight package. This paper describes the physical layout and performance of some typical magnetic hysteresis dampers. Design considerations are given for each of the system components: Flexural suspension, protection system, and damping system. Emphasis is given to techniques for achieving adequate damping, even for small angles of rotation, and to design features which make the suspension system extremely rugged. Methods are described for making the damping mechanism insensitive to environmental changes. Test results demonstrating the performance characteristics of magnetic hysteresis dampers for typical operations and environments are presented. Author

N66-36336*# Philco Corp., Palo Alto, Calif. WDL Div.

DEVELOPMENT OF A DAMPER FOR PASSIVE GRAVITY-GRADIENT STABILIZATION

Stephen Marx *In* NASA, Washington Symp. on Passive Gradient Stabilization 1966 p 145–155 (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The heart of a gravity-gradient stabilization system is the energy-dissipating device which may take one of many forms depending on the configuration to be stabilized. This paper outlines the development of a passive damper device suitable for a particular class of gravity-stabilized satellite. The class to be considered utilizes two or more hinged bodies joined by either single- or two-degree-of-freedom couplings. Relative motion between the two bodies is constrained by a spring restoring moment incorporated into the hinge damper, while suitable damping moments are generated as a result of this relative motion. The damper discussed in this paper utilizes diamagnetic materials in conjunction with permanent magnets to provide a free-floating suspension with the required spring restoring moments. Energy dissipation by means of eddy-current damping is accomplished by plating of the diamagnetic material with a suitable conductor. One of the most attractive features of the device is the fact that the effective spring constant can be varied by orders of magnitude merely by changing the shape of the diamagnetic material. The paper presents the range of damper parameters obtainable for various mission requirements and also presents test results and performance data for a particular configuration. Both one- and two-degree-of-freedom damper applications are considered. Author

N66-36337*# General Electric Co., Philadelphia, Pa.

PASSIVE DAMPER BEARING AND GRAVITY-GRADIENT ROD DEVELOPMENT

E. M. Mazur, D. N. Matteo, and R. S. Oxenreider *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 157–183 refs (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The paper discusses the design and development work in the field of passive dampers for gravity-gradient stabilization systems. In addition, the basic materials research and testing programs aimed at producing improved gravity-gradient rods are covered. The discussion on dampers covers the effort expended in the design of the eddy-current damper with the frictionless diamagnetic suspension and the associated low-order force test fixtures and facilities which were required to ground-test the

component. The unique magnetic torsional restraint required for gravity-anchored passive systems is also described. The culmination of this work is an eddy-current damper which will be flight-tested along with a magnetic hysteresis damper on the Applications Technology Satellite in 1966. The magnetically anchored viscous-fluid damper flight-tested successfully on a satellite in January 1964 is also described. The refinements made to this damper over the past year result in suspension and weight improvements and have been flight-tested on additional satellites during the past few months. A spherical magnetically anchored eddy-current damper is also discussed. In the field of gravity-gradient rods, early test work is described including the first testing of long rods in a thermal vacuum chamber to demonstrate the effectiveness of silverplating the rods to reduce thermal bending. Author

N66-36338*# Philco Corp., Palo Alto, Calif. WDL Div.
STATION DEEPING FOR GRAVITY-GRADIENT-STABILIZED SATELLITES
Helmut K. Hartbaum *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 201-220 refs (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The compatibility of gravity-gradient stabilization with station keeping is investigated. After a brief review of typical propulsion requirements, various possible modes of satellite propulsion are discussed. Attitude perturbations caused by orbit control thrust are assessed, and the sensitivity of a gravity-stabilized satellite to such perturbations is analyzed. Two specific satellite configurations, an all-passive, three-body configuration and a flywheel-augmented two-body configuration, are compared on the basis of station-keeping performance. Digital computer simulations presented for a qualitative evaluation of the two stabilization concepts show the expected stabilization errors at synchronous altitude for both east-west and north-south station keeping in a synchronous, equatorial orbit. Author

N66-36340*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ENERGY APPROACH TO PASSIVE GRAVITY-GRADIENT-STABILIZED SATELLITE CAPTURE PROBLEM
De Lamar M. Watson *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 227-235 refs (See N66-36326 21-21) GPO: HC $1.75; CFSTI: MF $1.75

All gravity-gradient-stabilized satellites have a stable orientation which is either right side up or upside down. If, after deployment of the stabilization system, the attitude and angular velocity are sufficient to cause tumbling, the final orientation may be upside down. In this paper an energy approach is described which provides a simple means of estimating those combinations of postdeployment attitude and angular velocity for which tumbling is possible. A procedure is given for relating the predeployment and postdeployment angular velocities and attitudes to each other. The method can therefore be used for deciding whether capture will occur after separation from a launch vehicle or whether a turnover device will be required. Author

N66-36341*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ORBITAL RESULTS FROM GRAVITY-GRADIENT-STABILIZED SATELLITES
Frederick F. Mobley and Robert E. Fischell *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 237-251 refs (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The possibility of using the Earth's gravity field for vertical stabilization of near-Earth satellites has intrigued theoreticians for many years. The very small stabilizing torque available and the lack of a natural damping mechanism have been recognized as the major problems. The satellite 1963-22A launched in June 1963 was the first orbiting vehicle to achieve passive gravity-gradient attitude stabilization successfully. The initial spin of the satellite was removed by mechanical and magnetic despin devices. An internal electromagnet was then energized to align the satellite along the local magnetic field direction. Twelve hours later when the satellite passed over the North Magnetic Pole it was vertical with the correct side facing Earthward. A 100-foot boom was then extended from the satellite and the magnetic dipole was turned off. Libration damping was provided by the combination of lossy spring and magnetic hysteresis rods. Within a week after boom deployment, the peak angle of oscillation of the satellite was damped below 10°. Other satellites 1963-38B and 1963-49B used the combination of a lossy spring and magnetic rods in a configuration that was virtually identical to that of satellite 1963-22A. The satellite 1964-26A achieved gravity stabilization using only 0.6 pound of magnetic hysteresis rods to damp the peak libration angle from 40° to 7° in a period of approximately 4 days. Author

N66-36342*# Naval Research Lab., Washington, D. C.
SYSTEM PERFORMANCE AND ATTITUDE SENSING OF THREE GRAVITY-GRADIENT-STABILIZED SATELLITES
R. T. Beal, P. H. Cudmore, R. H. Kronke, and P. G. Wilhelm *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 253-269 (See N66-36326 21-31) GPO: HC $1.75; CFSTI: MF $1.75

The advantages of a passive control system which alines a satellite axis along the local vertical prompted the flight-test of three gravity-gradient control systems at low altitude (500 n. mi.). Two 2-axis and one 3-axis stabilized satellites were flown to stabilize the controlled satellite axis to within ±10°. Attitude sensing was accomplished on all three satellites by nonoptimum earthlight detectors. In addition, the three-axis satellite had a magnetic and solar aspect system aboard. All satellites achieved low-eccentricity circular orbits of 500 n. mi. Raw uncorrected data show that both of the 2-axis stabilized satellites have achieved steady-state alinement to the local vertical within 10°. Corrected data on a sufficient number of data points indicate alinement to the local vertical within 6°. Two intentional inversion maneuvers were successively completed with one of the 2-axis stabilized satellites. The mechanism for doing this was retraction of the gravity-gradient boom to half length, a coast phase, and reextension of the boom. No appreciable data were collected during these maneuvers, but alinement to the local vertical within 6° is known to have occurred within five revolutions after both maneuvers. Author

N66-36370*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARINER MARS 1964 MECHANICAL CONFIGURATION
R. J. Spehalski 1 Sep. 1966 28 p refs
(Contract NAS7-100)
(NASA-CR-77981; JPL-TR-32-933) CFSTI: HC $2.00/MF $0.50 CSCL 22B

This report summarizes the design considerations for the mechanical configuration of the Mariner Mars 1964 spacecraft. Sources of various configuration design requirements are discussed, including the launch vehicle and the spacecraft system and its subsystems. The evolution of the design, representative problems encountered during the configuration evolution, and criteria used in evaluation of succeeding iterations—satisfaction of subsystem requirements, structural efficiency, operational simplicity, and growth potential—are presented. The resultant design is described and evaluated relative to the proposed criteria. Finally, conclusions and recommendations are given that may be of value in mechanical configuration design for future projects. Author

N66-36421*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MANUFACTURING RESEARCH IN SUPPORT OF SATURN V
James R. Williams *In its* Mfg. Res. at MSFC 1965 p 3-14 (See N66-36420 21-34) CFSTI: HC $2.00/MF $0.50

Research achievements applicable to the production of Saturn V components are described, including high pressure liquid and pneumatic ducting systems; age forming and sizing; welding, composite structure, and tooling research applications; and chemical milling. Leakage at the mechanical connections in high pressure lines was minimized by precisely flared tubes; flaring to close tolerance was done with an orbital flaring adapter, and the forming operation was controlled with an electronic control console. A technique of aging aluminum materials was used to form cylindrical tank segments and double contoured gore segments and to remove weld distortions. Control of weld porosity was improved by using a gas metallic arc method for two pass welding, and thinner gauge aluminum welding (e.g., LOX tunnel to fuel bulkhead). Adhesive studies were applied to the use of brackets and fasteners on Saturn wall structures and strengthening and repairing substandard tank structures. Tooling costs were reduced by using a skate-type cooling for S-IC gore-edge trimming. Control techniques for milling by chemical etching were developed and used for gore segments. L.E.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-35364# California Univ., Berkeley. Coll. of Engineering.
THE LINEAR THEORY OF AN ELASTIC COSSERAT PLATE
A. E. Green and P. M. Naghdi (Newcastle-upon-tyne) Apr. 1966 37 p refs
(Contract Nonr-222(69))
(AM-66-4; AD-635176) CFSTI: HC $4.00/MF $0.50

Some features of the linear theory of an elastic cosserat plate are discussed and special attention is given to a bending theory for isotropic materials. A useful representation for the solution of the system of differential equations characterizing the bending of an isotropic and elastic cosserat plate is deduced, and the results are applied to the problem of an infinite cosserat plate with a circular hole, the plate being in a state of uniform bending at infinity. Author (TAB)

N66-35383# Naval Ordnance Lab., White Oak, Md.
PHONON SPECTRUM OF A SHOCKED SOLID
Paul Harris 13 May 1966 87 p refs
(NOLTR-66-43; AD-635077) CFSTI: HC $3.00/MF $0.75

A Boltzmann equation approach is used to investigate the phonon distribution in a solid undergoing finite amplitude shock loading. Phonon-phonon interactions, via the anharmonic content of the crystal, lead to a collision term in the spirit of the Callaway thermal conductivity model. The theory is used to consider the phonon-phonon attenuation of a shock wave. In order to complement the microscopic theory, some macroscopic theory is considered. Author (TAB)

N66-35463# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
PLASTICITY
B. Venkatraman Apr. 1966 95 p refs Submitted for Publication
(Contract AF 49(638)-1360)
(PIBAL-916; AFOSR-66-0709; AD-635096) CFSTI: HC $6.00 MF $0.75

The present report is an introduction to the subject of plasticity on a microscopic scale. A coherent presentation of the material has been attempted, with the principal aim of drawing attention to significant developments. In the latter context, limitation of space has precluded the discussion of each and every topic that come under the heading of plasticity. Thus, for example, the phenomena of creep, plastic waves and plastic buckling has example, the phenomena of creep, plastic waves and plastic buckling have not been included. However, omission of lengthy descriptions and derivations has enabled the treatment of a reasonably wide range of topics. While the basic concepts are discussed in the first chapter, the subsequent chapters deal with the solution of problems. Here, the choice of problems has been guided by their simplicity in illustrating the theory and are by no means complete. For details of analyses and the treatment of more advanced problems, the reader must refer to the books and papers cited at the end of the report. Author (TAB)

N66-35464# California Univ., Berkeley Div. of Applied Mechanics.
LINEAR NON-ISOTHERMAL VISCOELASTIC SOLIDS
R. M. Christensen and P. M. Naghdi Apr. 1966 23 p refs
(AM-66-5; AD-635177) CFSTI: HC $1.00/MF $0.50

With the use of a suitable representation for the free energy, explicit forms of the constitutive relations, the dissipation function and related thermodynamical restrictions are derived for infinitesimal deformation of linear non-isothermal viscoelastic solids. Some remarks on further restrictions, consistent with the dissipation inequility, are included for isothopic materials. Author (TAB)

N66-35601*# Geological Survey, Washington, D. C.
CHANGE OF EFFECTIVE TARGET STRENGTH WITH INCREASING SIZE OF HYPERVELOCITY IMPACT CRATERS
D. E. Gault, E. D. Heitowit (NASA, Ames Research Center), and H. J. Moore *In its* Astrogeol. Studies. Part D: Studies for Space Flight Program May 1964 p 52-63 refs (See N66-33596 21-30) CFSTI: HC $4.00/MF $1.00 CSCL 20K

Experimental data indicate that the mass ejected from craters produced by hypervelocity and high velocity projectile impace with basalt increases with (1) projectile energy, (2) square root of the ratio of the projectile and target density, and (3) size of the resulting crater. The amount of mass ejected for each unit of projectile energy that has been corrected for density ratio increases with the size of the resulting crater, and a decrease in effective target strength accompanies the increase in crater size. Data were accumulated from the firing of aluminum, steel, and polyethylene projectiles in an air or nitrogen atmosphere at pressures between 2 and 75 mm. The mass of basalt ejected from each crater was determined by (1) weighing the target block before and after impact, (2) weighing recovered ejecta, (3) multiplying target density by crater volume, and combination of these methods. Target strength and failure are discussed, and changes in measured strength with size of test specimen is considered. M.W.R.

N66-35607# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ON THE EQUATION FOR AXISYMMETRIC DEFORMATION OF SHALLOW SHELLS OF REVOLUTION
K. A. V. Pandalai and Clive L. Dym Apr. 1966 35 p refs
(Contract AF 49(638)-1276)
(SUDAAR-267; AFOSR-66-0724; AD-635095) CFSTI: HC $2.00/MF $0.50

The equations governing the axisymmetric deformation of shallow shells (caps) of revolution are derived without introducing the simplifying assumption concerning the transverse shear force that is basic to the Mushtari-Vlasov approximation of thin shell theory. The equations derived are then specialized for the case of shallow spherical caps and compared with the Reissner equation which is a special case of the Mushtari-Vlasov approximation. Two problems are solved and the results are compared with the corresponding solutions of the Reissner equation. Author (TAB)

N66-35642# Bureau of Ships, Washington, D. C.
STRESS STATE NEAR A RECTANGULAR OPENING WITH CURVED ANGLES IN A CYLINDRICAL SHELL
O. M. Guz' and S. O. Goloborod'ko Apr. 1966 9 p refs Transl. into ENGLISH from Prik. Mekh. (Kiev), v. 10, no. 6, 1964 p 594–599
(Bushps-Trans-983; TT-66-61386; AD-633582) CFSTI: HC $1.00/MF $0.50

An approximate solution to the problem of determining the stress state near a rectangular opening with curved angles in a cylindrical shell, which is loaded with uniform internal stress of intensity P_0 is presented. The solution is obtained by the disturbance of the boundary shape method. Author

N66-35657*# Georgia Inst. of Tech., Atlanta.
THE AXISYMMETRIC RESPONSE OF CYLINDRICAL AND HEMISPHERICAL SHELLS TO TIME-DEPENDENT LOADING
James Ting-shun Wang, Wolfram Stadler, and Chi-wen Lin Washington, NASA, Sep. 1966 35 p refs
(Grant NsG-571)
(NASA-CR-572) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The bending theory of thin shells is used to obtain the dynamic response of a complete cylindrical shell of finite length. The shell is subjected to axisymmetric dynamic loads, normal to the shell surface. The effects of the inertial load in the longitudinal direction are assumed to be negligible. The general solution is exact within the theory, and it is presented in a concise from, which simplifies its application to specific boundary-value problems. The natural frequencies are calculated from transcendental equations obtained by the application of the respective boundary conditions to the general solution. An illustrative example of a clamped cylindrical shell subjected to uniform shock with linear decay is presented, including numerical results. Author

N66-35672# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
INFLUENCES OF TEMPERATURE CHANGE AND LARGE AMPLITUDE ON FREE FLEXURAL VIBRATION OF RECTANGULAR ELASTIC PLATES
Megumi Sunakawa Jun. 1966 27 p refs *Its* Vol. 31, No. 3 (ISAS-402) CFSTI: HC $2.00/MF $0.50

The fundamental equations of nonlinear flexural vibration for a rectangular elastic plate are solved approximately by employing a method of successive approximation, and the influences of the temperature change and large amplitude on the period of free vibration are established. Some numerical examples are given for a plate with hinged and immovable edges, and it is shown that the effects mentioned above are considerably large and cannot be ignored even when the temperature change is small. Author

N66-35714# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FEASIBILITY STUDY OF AN EXPANDABLE SPACE MAINTENANCE HANGAR
Michael Roy Keating (M.S. Thesis) Mar. 1966 123 p refs
(AD-635383) CFSTI: HC $4.00/MF $0.75

To determine the feasibility of an expandable space-hangar, a composite wall using polyester terephthalate, 181 style glass cloth, polyurethane foam, and polyvinylidene chloride is designed to operate in a 500 kilometer circular orbit. The structure is cylindrical with hemispherical ends and has a length of 65 feet and a diameter of 25 feet. The wall affords occupants protection from radiation and meteoroids, has a low gas permeability, withstands an internal pressure of 7.5 lb/sq. in., and can be compressed into a launch package of 460 cu. ft. It is concluded that a design of an expandable space hangar is feasible. Author (TAB)

N66-35736*# California Univ., Los Angeles. Dept. of Engineering.
BENDING-STIFFNESS PROPERTIES OF A PRESTRESSED SEGMENTED CERAMIC PLATE
George Nikolaychik, R. B. Matthiesen, and W. J. Knapp Jun. 1965 39 p refs *Its* Rept.-65-26
(Grant NsG-427)
(NASA-CR-68114) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The structural characteristics of a prestressed segmented ceramic plate were investigated. The plate was composed of 1 in. thick square ceramic blocks held together by steel wire ropes. The experimentation involved two cylindrical bending tests to determine the flexural stiffnesses D_x and D_y, an anticlastic bending test to find the Poisson stiffness D_1, and two twisting tests to determine the twisting stiffness D_{xy}. The results were: D_x was 28,550 lb-in.^{2}/in., D_y was 13,450 lb-in.^{2}/in., and D_{xy} was 62,000 lb-in.^{2}/in. on the average. D_1 was very small, being 305 lb-in.^{2}/in. These stiffnesses were different at various plate locations because of nonuniformities of the plate prestress. The stiffness constants D_x, D_y, D_{xy}, and D_1 were also derived analytically from the geometries of the cross section and an effective elastic modulus E and an effective Poisson ratio μ of the composite plate. The flexural stiffnesses D_x and D_y were calculated to be 37,300 lb-in.^{2}/in., and 13,300 lb-in.^{2}/in., respectively, whereas D_{xy} was calculated to be 156,000 lb-in.^{2}/in. The Poisson stiffness D_1 was calculated to be 5,560 lb-in.^{2}/in. The agreement between the experimental and analytical stiffnesses was considered good. Author

N66-35813# California Univ., Livermore. Lawrence Radiation Lab.
PROPAGATION OF STRESS DISTURBANCES IN ELASTIC-PLASTIC CYLINDERS: ONE-DIMENSIONAL THEORIES
R. J. Wasley 21 Dec. 1965 72 p refs
(Contract W-7405-ENG-48)
(UCRL-14617) CFSTI: HC $2.00/MF $0.75

One-dimensional analytic treatments of propagation of stress disturbances in elastic-plastic cylinders are reported. When compared with experimental data from impact of solid high explosives, some of these theories are shown to predict in a reasonably satisfactory fashion the gross features of the deformation history. The presentation elucidates the basic mechanics and assumptions associated with the impact process, the understanding of which is a prerequisite to introducing further complexities into an analysis. Author (NSA)

N66-35838*# Astro Research Corp., Santa Barbara, Calif.
ON THE USE OF FILAMENT WOUND TOROIDS AS PNEUMATIC SHOCK ABSORBERS
Richard H. Mac Neal and Julius Loisch Washington, NASA, Sep. 1966 49 p refs
(Contract NASw-652)
(NASA-CR-574) CFSTI: HC $2.00/MF $0.50 CSCL 13G

This report contains the results of a study on the use of filament wound toroids as pneumatic shock absorbers. Expressions for the specific energy absorption under isobaric and adiabatic conditions are derived and compared with the performance of competing systems. Means for improving stroke efficiency are discussed. The stiffness properties of a compressed toroid under combined compression, bending and shear are derived analytically and compared with experimental measurements. In addition the buckling behaviour of a compressed stack of toroids is analyzed and compared with test results. In both cases the agreement between analysis and experiment is sufficiently good to validate the theory for engineering calculations. Author

N66-35984*# Bell Aerosystems Co., Buffalo, N. Y.
EFFECT OF LOCAL PRESSURE TRANSIENTS ON THE DEFORMATIONS AND STRESSES IN CYLINDRICAL DUCTS. VOLUME I: THEORY AND DESIGN CHARTS

Joseph Padlog and Herbert Reismann 26 Jun. 1966 225 p refs *Its* Rept.-2286-950002, Vol. I
(Contract NAS8-11215)
(NASA-CR-77774) CFSTI: HC $3.75/MF $1.25 CSCL 20K

Axially symmetric dynamic response solutions for infinite and finite length cylinders subjected to pressure transients which arise in propulsion systems are presented. Pressure transient types considered in detail are of the spike, step, ramp, and sinusoidal forms. Solutions for simple–simple and fixed–fixed boundary conditions are given and used as the basis for design charts which yield maximum stresses. A discussion of advanced problems is included. Author

N66-35985*# Bell Aerosystems Co., Buffalo, N. Y.
EFFECT OF LOCAL PRESSURE TRANSIENTS ON THE DEFORMATIONS AND STRESSES IN CYLINDRICAL DUCTS. VOLUME II: USER'S MANUAL FOR GENERAL PURPOSE PROGRAM
Walter Luberacki, Joseph Padlog, Herbert Reismann, and Yvonne M. Echenoz 26 Jun. 1966 84 p refs *Its* Rept.-2286-950002, Vol. II
(Contract NAS8-11215)
(NASA-CR-77773) CFSTI: HC $2.50/MF $0.75 CSCL 20K

A user's manual for a general purpose digital computer program capable of predicting the dynamic response of cylinders subjected to ramp and sinusoidal pressure transients is presented. The dynamic response for many traverses of a pressure transient from one end of the cylinder to the other can be computed by the program for the case where one end of the cylinder is closed by a valve and the other end attached to a relatively large container. Author

N66-35978*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
IMPROVEMENTS IN STRUCTURAL NONDESTRUCTIVE TESTING
R. W. Neuschaefer *In Its* Res. Achievements Rev. Ser. No. 10 1965 p 11–19 (See N66-35976 21-15) CFSTI: HC $2.00/MF $0.50

A time saving high-speed radiographic system that reduces radiation hazards was designed for inspecting bulkhead welds of Saturn I-C propellant fuel tanks. An ultrasonic inspection method, complementing radiography, was developed for inspecting seam- and spot-weld joints in type 2219 aluminum. This method is fast, provides a permanent printed record, and rapidly detects spurious weld defects. The feasibility of identifying various tempers of type 2219 aluminum was investigated through application of a technique of eddy-current induction and measurement. The "O" condition was found to be easily identified, and the T62 temper was the most difficult to identify. A zone-gradient pressurization system was conceived, and pressure seals and test fixtures designed, for testing a model-sized straight-wall tank under accurately simulated flight loading. The system is thought to improve development of lightweight tapered-wall propellant tanks. Author

N66-36006# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
AN EXPERIMENTAL STUDY OF THE RESPONSE OF A CANTILEVER PLATE TO RANDOME EXCITATION Final Report
J. F. Dalzell and L. M. Yeakley Nov. 1965 80 p refs

The results of an experimental investigation of the response of a cantilever plate to random excitation are presented. The experimental program involved force excitation of the cantilever plate at two points, while the response of the plate was measured at two other points. Sinusoidal excitation experiments were carried out to characterize the plate and to check the linearity and superpossibility of response. Random excitation experiments involving excitation at only one forcing point were carried out, and the plate response was derived from the resulting random records for comparison with the sinusoidal test results. Finally, the plate was excited at both forcing points simultaneously with statistically correlated, uncorrelated, and partially correlated random force time histories. Quite reasonable agreement was found between observed and predicted spectra for the multiple input case, and between the plate response derived from sinusoidal and single random force excitation experiments. The results of this investigation verify the applicability of established linear-random techniques to the cantilever plate case within accuracies appropriate in many design problems. Author

N66-36009# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
ELASTIC RESPONSE OF THIN SPHERICAL SHELLS TO AXISYMMETRIC TRANSIENT LOADING
Wilfred E. Baker, William C. L. Hu, and Thomas R. Jackson Aug. 1965 73 p refs
(TR-1)

Both an infinite series solution and a finite difference solution have been obtained to the problem of elastic response of a complete, thin, spherical shell to axisymmetric transient pressure loading. The two solutions are compared to each other for two specific examples, and are also compared with previously published experimental data for one of the examples. The authors conclude that either solution is usable for engineering predictions of dynamic shell response. They also recommend conduct of more carefully controlled experiments for comparison with theory. Author

N66-36018# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
PLASTIC RESPONSE OF THIN SPHERICAL SHELLS TO AXISYMMETRIC TRANSIENT LOADING
Wilfred E. Baker Oct. 1965 34 p refs
(TR-2)

Equations of motion are presented for rigid-plastic and elastic-plastic response of thin spherical shells to axisymmetric transient loading. Solutions for initial phases of motion are given, and problems encountered in obtaining solutions during later phases are discussed. Author

N66-36041# Air Force Systems Command, Wright–Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING LARGE CAMBERS OF A FASTENED CYLINDRICAL THREE-LAYER PANEL WITH A LIGHT FILLER UNDER THE ACTION OF NORMAL UNIFORM PRESSURE
V. F. Karavanov 19 May 1965 17 p refs Transl. into ENGLISH from Vopr. Prochnosti i Ustoychivosti Elementov Tonkostennykh Konstrukt., Aviats. Inst. (Moscow), no. 1, 1963 p 97–109
(FTD-MT-63-269; TT-65-63122; AD-619548) CFSTI: HC $1.00/MF $0.50

Consideration is given to an approximate solution of the problem concerning large cambers of a fastened right-angle sloping cylindrical three-ply panel with a light filler under the action of normal uniform pressure. Determination is made of the value of the curvature of the shell, with which the cylindrical panel at a given rigidity of filler upon shearing, bulges due to buckling; the upper and lower critical pressures for the panels; the behavior of the shell for the case of the immobile and mobile edges of the panel. TAB

N66-36085*# Lockheed-Georgia Co., Marietta. Engineering Development Test Labs. Div.
BIREFRINGENT COATINGS FOR NONDESTRUCTIVE TESTING OF HONEYCOMB SANDWICH STRUCTURES Final Engineering Report No. 8379, 30 Jun. 1965–15 Mar. 1966

W. M. Mc Gee, Mar. 1966 85 p refs
(Contract NAS8-11972)
(NASA-CR-77759) CFSTI: HC $3.00/MF $0.75

An epoxy type birefringent coating applicable using conventional paint spray type equipment was developed. The premixed coating components exhibited long pot life in large quantities, and when sprayed, cured in a short time to produce a relatively high strain-optic coefficient. The coating was evaluated for nondestructive testing of honeycomb sandwich panels having simulated face sheet bondline voids. Perforated core allowed the panels to be pressurized which produced strain discontinuities in the face sheets at void locations. These discontinuities were made visible by the birefringent coating sprayed on the face sheet. Optimal coating thicknesses for aluminum alloy face sheets up to 0.100 inch thick were determined. Coating removal evaluations were made, and results for limited investigations of a promising polyurethane type birefringent coating are presented. Author

N66-36094*# National Aeronautics and Space Administration. Langley Research Station, Va.
A MODIFIED-STRIP-ANALYSIS METHOD FOR PREDICTING WING FLUTTER AT SUBSONIC TO HYPERSONIC SPEEDS
E. Carson Yates, Jr. [1964] 22 p refs
(NASA-TM-X-54830) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The modified-strip-analysis method of flutter prediction is reviewed briefly, some of its limitations are examined, its relations to some other strip methods are indicated, and some results of its use are shown in comparison with experimental flutter data and with results of other analytical methods for Mach numbers up to 15.3. The modified strip analysis is formulated from Theodorsen's method and employs distributions of aerodynamic parameters which may be evaluated from any suitable linear or nonlinear steady-flow theory or from measured steady-flow load distributions for the undeformed wing. The method has been shown to give good flutter results for a broad range of swept and unswept wings at speeds up to hypersonic. The method, however, is not suitable for application to wings of very low aspect ratio nor to unswept wings at Mach numbers near 1.0. Author

N66-36111*# Massachusetts Inst. of Tech., Cambridge.
ANALYSIS OF A SPHERICAL SHELL WITH A NON-AXISYMMETRIC BOUNDARY
Z. M. Elias and P. K. Ho Washington, NASA, Sep. 1966 33 p refs
(Grant NGR-22-009-059)
(NASA-CR-567) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A formulation of the spherical shell problem in terms of stress functions is presented and applied to the case of a special non-axisymmetric boundary. The boundary is described by four circular arcs whose stereographic projection from pole P on the equatorial plane is a rectangle centered at the center of the sphere. The geometry of the boundary curves and the coordinates used in the solution of the problem are in relation to properties of the stereographic projection of a sphere. Only the interior state of stress is considered through use of the membrane and inextensional solutions. The homogeneous membrane solution for zero surface load is given, as is a simple particular solution of a shell with a circular boundary for certain stress resultants and displacements. Discussed are: inextensional bending, determination of displacements, and stress boundary conditions. Formulas are also expressed for computation of the coefficient matrix, and constant vector. R.L.I.

N66-36112*# Massachusetts Inst. of Tech., Cambridge.
A DUAL FORMULATION OF THIN SHELL THEORY
Z. M. Elias Washington, NASA, Sep. 1966 32 p refs
(Grant NGR-22-009-059)
(NASA-CR-568) CFSTI: HC $2.00/MF $0.50

A formulation of the equations for stress functions and thin elastic shells, including a discussion of the static geometric analogy and of the different types of stress states, is presented. It is pointed out that the proposed system of stress strain relations has not apparently been used before; it was derived, however, from an accepted form of the complementary strain energy function, and led to results in accordance with those of other established formulations. It is considered to have a simple form and is invariant in a change of curvilinear coordinates. R.L.I.

N66-36117*# Arizona State Univ., Tempe.
A GREEN'S FUNCTION APPROACH TO THE VIBRATION OF THIN SPHERICAL SHELL SEGMENTS
James P. Avery Washington, NASA, Sep. 1966 37 p refs
(Grant NGR-03-001-013)
(NASA-CR-602) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Investigated was the development of a Green's function approach to the undamped, linear vibration of thin spherical shell segments, and the vibration analysis which can be adapted to arbitrary boundary conditions prescribed along the segment edge. The vibration problem considered was first replaced by an equivalent static problem and the relationship expressed symbolically. A mathematical discussion and governing differential equations (in terms of displacements) are presented for the two fundamental problems requiring solution in order to provide the necessary Green's functions. These two fundamental problems are defined by the application to the spherical shell of: (1) a unit normal load, and (2) a unit tangential load. A third coordinate system is introduced to develop geometric relationships between the two surface coordinate systems (used in the development of the Green's functions) and the transformation relationships for surface vectors (or tensors). A formulation for Green's function solution is given. R.L.I.

N66-36123*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF EXPERIMENTAL AND THEORETICAL STRESSES AT A MISMATCH IN A CIRCUMFERENTIAL JOINT IN A CYLINDRICAL PRESSURE VESSEL
William C. Morgan and Peter T. Bizon Washington, NASA, Sep. 1966 19 p refs
(NASA-TN-D-3608) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An experimental evaluation was made of a theoretical analysis of the elastic stress distribution at a mismatched circumferential junction between thin-walled, internally pressurized cylinders (nominal stress field, 2 to 1). The test cylinders used in the investigation were of uniform wall thickness but had dissimilar radii on each side of the junction. The nominal ratio of radius to wall thickness was 75. Stress distributions were determined with electric-resistance strain gages which were mounted on the interior and exterior walls of four test cylinders, each with a different mismatched junction. Three cylinders were provided with tapered-fillet discontinuities of various degrees of mismatch; the fourth cylinder was made with an abrupt discontinuity at the mismatched junction. A correlation between test results and an analytically predicted stress distribution was established for each case. Author

N66-36124*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTIC STRESSES AT A MISMATCHED CIRCUMFERENTIAL JOINT IN A PRESSURIZED CYLINDER INCLUDING THICKNESS CHANGES AND MEREDIONAL LOAD COUPLING
Peter T. Bizon Washington, NASA, Sep. 1966 47 p refs
(NASA-TN-D-3609) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The results of an analytical investigation of stresses at a circumferential joint in a pressurized circular cylindrical vessel are presented graphically for a wide range of geometric values. This investigation of a mismatched joint with any thickness change

was performed for three types of junction geometry: unfilleted butt joint, filleted butt joint, and overlap joint. In the butt joints, the mismatch was varied from zero to the case where the inner surface of one cylinder coincided with the outer surface of the other cylinder. The lengths of overlap joints investigated varied from short lengths with discontinuity interactions to longer lengths with no interactions. Nonlinear edge influence coefficients, which were used to obtain the results, are presented for both semi-infinite and short-length cylinders. For a change in thickness at a circumferential joint in a cylindrical pressure vessel, it is less detrimental if the thinner section is displaced a small amount inward rather than outward from the thicker section if mismatch is to occur. If the thickness does not change at the junction of an unfilleted butt joint, a nonlinear stress analysis is not required to determine the mismatch stresses. For equal thicknesses at a filleted butt joint, a nonlinear analysis is required to determine accurately the mismatch stresses. Author

N66-36127*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
PREDICTION OF THE INVERSION LOAD OF A CIRCULAR TUBE
Le Roy R. Guist and Donald P. Marble Washington, NASA, Sep. 1966 21 p refs
(124-08-04-02)
(NASA-TN-D-3622) CFSTI: HC $1.00/MF $0.50 CSCL 20K

This study is concerned with the plastic deformation process encountered in the inversion or turning inside out of a circular tube. The load required to cause inversion is derived analytically from elementary expressions for plastic energy absorbed during uniaxial plastic straining. Analytical results are compared with the results of experiments conducted concurrently, and with previously reported results. Experimental values of inversion load agreed with analytical predictions within 10 to 30 percent. Author

N66-36162# Eidgenossische Technische Hochschule, Zurich (Switzerland).
BENDING STRESS DURABILITY OF CABLES [DAUER-BIEGEFESTIGKEIT VON DRAHTSEILEN]
Gabor Oplatka (Ph.D. Thesis) 1965 73 p refs In GERMAN
(Rept.-3566) CFSTI: HC $3.00/MF $0.75

The design and construction of a test apparatus to determine the bending stress resistance of wire cables is described. This construction uses a reeling drum and a supporting plate to subject the attached cable to tensile stress and shunt loading. Stress measurements on a wire cable of 1.8 diameter and a break resistance of $\sigma_B = 165$ kp/mm^2 showed that large surface pressure did not influence the tensile stress characteristics significantly, but the tensile stress increased with small steady surface pressure loading. Transl. by G.G.

N66-36225*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ENERGY DISSIPATION ASSOCIATED WITH GAS-PUMPING IN STRUCTURAL JOINTS
G. Maidanik 17 May 1966 50 p refs *Its* Rept.-1374
(Contract NAS5-9694)
(NASA-CR-77926) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Recent experimental work dealing with the vibratory energy dissipation of plates with beams riveted to them has indicated that the dominant damping mechanism is associated with gas-pumping in the space between the plate and the beam. Based on this deduction, a semi-phenomenological theory is developed which predicts satisfactorily not only the order of magnitude of the loss factors, but also their dependence on frequency and on gas pressure. This theory attributes the damping to viscous forces associated with gas motion tangential to the plane of the plate, resulting from the relative flexural motions between the adjacent plate and beam surfaces. Author

N66-36240# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
COMBINED INFLUENCE OF HIGHER-ORDER LINEAR EFFECTS AND NONLINEAR EFFECTS ON THE LATERAL VIBRATION BEHAVIOR OF SOLID AND SANDWICH BEAMS
J. Meyers and B. G. Wrenn Sep. 1964 48 p refs
(Contract DA-44-177-AMC-115(T))
(SUDAER-208; AD-632923) CFSTI: HC $2.00/MF $0.50

This report presents the results of a study of the combined influence of higher order linear effects and nonlinear effects on the lateral vibration behavior of solid and sandwich beams in the presence of axial load. The higher order linear effects considered are tranverse shear and rotatory inertia. The nonlinear effects considered are those which arise due to stretching of the longitudinal fibers of the beam during vibration. This stretching results from the consideration of variable axial boundary restraint. The predicted vibration behavior provides new design information for solid and sandwich beams of either metal or plastic construction, and correlates excellently in various limiting cases with the theoretical and experimental results obtained by previous investigators. Author (TAB)

N66-36286# Lockheed Missiles and Space Co., Palo Alto, Calif.
NATURAL BENDING–TWISTING VIBRATIONS OF A FREE BEAM OF VARIABLE MASS AND STIFFNESS UNDER CONCENTRATED LOADINGS
K. IA. Kukhta [1966] 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 6, 1966 p 737–740

A method is presented for determining the natural bending–twisting frequencies and modes of vibrations of a free beam of variable mass and stiffness under concentrated loadings. R.N.A.

N66-36287# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON A METHOD OF INVESTIGATING THE STABILITY OF A CYLINDRICAL SHELL UNDER LONGITUDINAL IMPACT
V. I. Borisenko [1966] 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 7, 1966 p 875–878

A method of determining the stability of a cylindrical shell subject to longitudinal impact is proposed. It is assumed that under impact the shell buckles only on that portion along which a longitudinal compression wave is propagated. Variational equations describing the vibrations of these portions of the shell are given. Using the Galerkin method, these are reduced to a system of ordinary differential equations. The problem is then reduced to an investigation of the stability of the unperturbed motion of a system with variable coefficients in a finite time interval, since the impact loading acts during a certain time. R.N.A.

N66-36289# Lockheed Missiles and Space Co., Palo Alto, Calif
ON RANDOM VIBRATIONS OF AN ELASTIC ELEMENT, ACCOMPANIED BY ENERGY DISSIPATION IN THE MATERIAL
V. M. Goncharenko [1966] 9 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR. (Kiev), no. 6, 1966 p 733–737

In problems connected with the study of forced vibrations of elastic elements, an element may often be imagined as a system with one degree of freedom. The vibrations are described by the equation (1) $\ddot{q}+2h\dot{q}+\omega^2[q+F(q)]=\S(t)$, where $\S(t)$ is the generalized perturbing force, h characterizes the external supporting force, and the nonlinear function F (q) describes the hysteresis losses in the material of the element. Usually the case when the force $\S(t)$ is harmonic in nature is considered in investigations of forced vibrations. The dependence of the amplitudes of the stationary vibrations of the system (1) on the frequency and amplitude of the harmonic force $\S(t)$ has been studied, however, the practical utilization

of the results may be difficult since actual perturbing forces are not harmonic in nature, but are frequently not even periodic. The concept of amplitudes and frequencies as unique characteristics of such forces (and also of the vibrations) loses its value. The approximation of these forces by other kinds of functions is seldom expedient because of the growth in mathematical difficulty. Their determination is just of academic value, since the information on the perturbations in practice is insufficient to realize such an approximation. Under these conditions it is expedient to consider §(t) the realization of some random process. Author

N66-36290# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ANALYSIS OF THE DAMPING OF SHELL VIBRATIONS IN A FLUID
V. S. Gontkevich [1966] 14 p refs Transl. into ENGLISH from Energy Dissipation in Vibrations of Elastic Systems (Kiev), 1966 p 104–115

To compute the vibrations of shells in a viscous fluid, it was necessary to determine the viscous fluid motion under the effect of forces acting from the shell walls. Equations which describe the fluid motion are derived, and it is stated that the generalized force acting on the shell from the fluid may be found and the Lagrange equation formulated for each of the generalized coordinates. To illustrate the procedure for the computation, an example of the plane bending vibrations of a cylindrical shell in a viscous fluid is considered. It is shown that the influence of the fluid viscosity on the natural vibration frequency is insignificant for the acoustic-band frequencies and the majority of real fluids; hence, in computing the integral characteristics if shell vibrations in a fluid, the ideal fluid theory may be applied. H.S.W.

N66-36293# Lockheed Missiles and Space Co., Palo Alto, Calif.
DYNAMIC INSTABILITY OF RANDOM VIBRATIONS OF A ROD
V. M. Kuz'ma [1966] 7 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhan. Fiz. (USSR), v. 2, no. 6, 1966 p 122–124

Equations are presented for studying the dynamic instability of the fundamental tones of longitudinal–transverse vibrations of a rod under free flight conditions. These equations for investigating the case when the fluctuations are white noise with unit spectral density, and for such times as when the transients associated with the initial conditions are damped out. From the instability conditions which were obtained, it was deduced that, if twice the frequency of the fundamentals of the transverse vibrations is close to the frequency of some tone of the longitudinal vibrations, unstable vibrations may originate. M.G.J.

N66-36294# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE INFLUENCE OF THE STATIONARY THERMAL FIELD ON THE STRESS CONCENTRATION IN AN INFINITE ELASTIC PLANE WITH A CIRCULAR CUTOUT
V. L. Fomin [1965] 8 p ref Transl. into ENGLISH from Stress Concentration (Kiev), no. 1, 1965 p 294–298

Consideration is given to the problem of the stress state in an elastic plane with a circular cutout in the presence of a stationary heat field, satisfying the condition of boundedness at infinity and the boundary conditions on the contour of the cutout. It is stated that there are no external forces on the contour of the hole, and the stresses at infinity equal zero. The solution to the problem is derived by applying the known analogy between the temperature stresses and the stresses originating because of dislocations. The obtained solution is extended to the case of elliptical and other holes of such kind, for which the function realizing the conformal mapping of a plane with a hole into a plane with a circular cutout is known. The development of the solution equations is demonstrated, and several graphs of the functions are included. A.G.O.

N66-36295# Lockheed Missiles and Space Co., Palo Alto, Calif.
INFLUENCE OF CREEP OF THE MATERIAL ON STRESS CONCENTRATION AROUND A CIRCULAR HOLE IN A PLATE
L. P. Khoroshun [1959] 9 p refs Transl. into ENGLISH from Stress Concentration (Kiev), no. 1, 1965 p 299–304

The influence of material inelastic behavior on the stress distribution around the plate hole is studied on the basis of the nonlinear theory of steady state creep flow. The solution of the problem is presented by successive approximations, beginning with the stress-strain relations used in flow theory. A biaxial stress state of a plate with a circular hole is considered, and resulting cases obtained from this examination such as multilateral tension, uniaxial tension, and pure shear are investigated. It is pointed out that the results obtained can be applied to the case of a nonlinearly elastic plate with a hole by replacing the time operators with appropriate constants. A.G.O.

N66-36302*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
A REVIEW OF ANALYTICAL METHODS USED TO DETERMINE THE MODAL CHARACTERISTICS OF CYLINDRICAL SHELLS
Kevin Forsberg Washington, NASA, Sep. 1966 71 p refs Presented at the 7th Intern. Aeron. Congr., Paris, 14–17 Jun. 1965
(NASA-CR-613) CFSTI: HC $2.50/MF $0.75 CSCL 20K

Most investigations have used approximate methods to determine the dynamic behavior of cylindrical shells. A recent paper has discussed results obtained by an exact solution of the differential equations of motion as derived by Flügge. By this method determinations can be made of the modal characteristics of a thin-walled cylindrical shell having arbitrary homogeneous boundary conditions. Thus for the cylindrical shell it is now possible to examine solutions obtained by various approximate techniques, using the exact solution as a basis of comparison. Results obtained by energy and finite difference techniques, as well as exact solutions for simplified (Donnell) differential equations, are compared. The effect of omitting inplane inertia is also examined. The comparisons are made on the basis of natural frequency, mode shape, and modal force distribution, and an indication is given of the time required for solution by the different methods on a high-speed digital computer. This review has considerable importance in providing a means to guide the investigator in making an appropriate choice of method of solving problems in dynamic response of spacecraft structures for which the exact solution is not available or is too cumbersome. Author

N66-36338*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
APPLICATION OF VISCOELASTIC MATERIALS TO GRAVITY-GRADIENT DAMPER AND BOOM TECHNOLOGY
D. R. Payne *In* NASA, Washington Symp. on Passive Gravity-Gradient Stabilization 1966 p 185–197 refs (See N66-36321-31) GPO: HC $1.75; CFSTI: MF$1.75

Viscoelastic materials have been used in the design of simple, rugged, and effective damper mechanisms and deployable booms for gravity-gradient systems. Gravity-gradient damper design is complicated by the necessity for achieving long characteristic times (ratio of damper to spring constant) for the dissipative joint. The application of viscoelastic polymers having long relaxation times to mechanize a dissipative flexure is shown to lead to an extremely simple, lightweight damper having viscous damping properties without threshold effects or amplitude-dependent damping. Damping effectiveness can be maintained at low joint stiffness levels and at very low frequencies typical of satellite libration. Deployable boom structures can show improved thermal bending performance when the boom design is based on a folded assembly of rigid boom elements connected by spring-loaded joints. Dissipation of the stored energy and control of deployment dynamics of such booms are practical design

problems which may be solved by employing a viscoelastic deployment damper integrated within the joint. The resulting deployment can be designed to be greatly overdamped with a very simple joint mechanism. The design features, space environmental properties, and thermal design considerations of such booms and dampers are discussed. Author

N66-36343*# Astro Research Corp., Santa Barbara, Calif.
A CONTRIBUTION TO THE MICROMECHANICS OF COMPOSITE MATERIALS—STRESSES AND FAILURE MECHANISMS INDUCED BY INCLUSIONS
H. Schuerch Washington, NASA, Sep. 1966 68 p refs
(Contract NAS7-427)
(NASA-CR-582) CFSTI: HC $2.50/MF $0.75 CSCL 20K

Stress function methods are used to determine the field of stress concentrations produced by cylindrical inclusions in an otherwise homogeneous matrix material subject to an applied stress transverse to the inclusion axis. It is found that the stress field generated by single cylindrical inclusions can be completely characterized by two non-dimensional constants that depend upon the relative elastic properties of the composite. Additional results are given for the case of an inclusion in the form of a spherical void. The stress field is presented graphically in the form of stress surfaces for a number of selected cases. The calculated stress fields are interpreted in terms of fracture mechanics for non-ideally loaded fiber composites, and for several types of polycrystalline ceramics. Based upon the analytical studies, guidelines are developed for composites using advanced types of microgeometry. Several promising approaches are reduced to the fabrication of laboratory test specimens. Author

N66-36360# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
THE SIGNIFICANCE OF FATIGUE CRACKS IN THE MICRO-RANGE AND THE MACRO-RANGE—A REVIEW
J. Schijve May 1966 57 p refs Presented at 69th Ann. Meeting of the Am. Soc. for Testing and Mater., Atlantic City, 27 Jun.–1 Jul. 1966 *Its* Paper No. 40
(MP-243) CFSTI: HC $3.00/MF $0.50

The fatigue phenomenon can be described as a sequence of four phases: (1) crack nucleation, (2) microcrack propagation, (3) macrocrack propagation and (4) final failure. The last phase is not discussed. Technical problems related to the other phases are indicated. The continuum mechanics approach is discussed, including the application of the stress intensity factor to microcracks and macrocracks. Several factors are mentioned that cannot be accounted for by continuum mechanics. Questions regarding the microstructural aspects of crack growth are analysed and a tentative model for crack growth is outlined. The discussion is illustrated by results of recent NLR investigations regarding the growth of microcracks and the influences of several factors on the propagation of macrocracks, including mean stress, variable-amplitude loading, sheet thickness, sheet width, heat treatment, manufacture, batch, rolling direction, environment and frequency. All data apply to aluminum alloys and mainly to 2024-T3. The main results of the paper are summarized in a number of conclusions, and problems for further research are listed. Author

N66-36369*# General Electric Co., Philadelphia.
PEAK PRESSURES IN THICK TARGETS GENERATED BY REDUCED DENSITY PROJECTILES
J. F. Heyda and T. D. Riney Washington, NASA, Sep. 1966 47 p refs
(Contract NAS3-4176)
(NASA-CR-609) CFSTI: HC $2.00/MF $0.50

An existing analytical method for calculating peak pressures in thick targets impacted by end-on oriented cylindrical projectiles of like material at hypervelocities is extended to cover the case of projectiles of subnormal bulk density. Projectiles and target are assumed to be of aluminum. Projectile densities assumed in the study are 2.702, 0.9, 0.44, 0.2 and 0.1 gm/cc. Two impact velocities are considered, 20 km/sec and 7.6 km/sec. It is shown that the method gives good agreement with computer program (PICWICK) calculations which evaluate numerically the hydrodynamic phase of impact at 20 km/sec with projectiles of densities 2.702, 0.9 and 0.44 gm/cc. The method is then employed to investigate impacts at the lower densities, 0.2 and 0.1 gm/cc, and at the two impact velocities, 20 km/sec and 7.6 km/sec in order to investigate variation in peak axial pressure propagating into the target as a function of projectile density. Author

N66-36394# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
THE ORTHOTROPIC CYLINDER: AN APPLICATION TO FIBER-WOUND SHELLS INCLUDING THE EFFECT OF TRANSVERSE STRESSES Sixth Technical Report
Arthur P. Boresi and John L. Ford Jun. 1966 29 p refs
(Grants NSF GP-903)
(T+AM-290)

A general theory of axisymmetric elastic shells of moderate thickness is applied to an orthotropic cylindrical shell with elastic constants falling approximately in the range of fiber-reinforced resins. Expressions for stress components and stress results, including transverse stress effects, are presented. Tables and figures are included to show the numerical data for specific load and end conditions. The results indicate that the nature of the stress resultants and moments is strongly influenced by material anisotropy and by transverse stress effects. M.G.J.

N66-36400# Brown Univ., Providence, R. I. Div. of Engineering.
IMPACT ON RODS OF NON-LINEAR VISCOPLASTIC MATERIAL—NUMERICAL AND APPROXIMATE SOLUTIONS
T. C. T. Ting and P. S. Symonds May 1966 38 p refs
(Contract DA-19-020-AMC-0077(R); ARPA Order 71)
(TR-3; AD-634700) CFSTI: HC $2.00/MF $0.50

A numerical technique is described for the solution of impact on finite rods in which the strain rate is assumed to be a function of stress and strain. Examples are given for the strain rate function taken as a power of the dynamic overstress and the results are compared with available analytic solutions and approximate uniform strain theory. Author (TAB)

N66-36402# Brown Univ., Providence, R. I. Div. of Engineering.
AN ANALYSIS OF COMBINED LONGITUDINAL AND TORSIONAL PLASTIC WAVES IN A THIN-WALLED TUBE
R. J. Clifton May 1966 30 p refs
(Contracts DA-19-020-AMC-0077(R); ARPA SD-86; ARPA Order 71)
(TR-5; AD-634701) CFSTI: HC $2.00/MF $0.50

This paper presents a one-dimensional rate independent theory of combined longitudinal and torsional plastic wave propagation in a thin-walled cylindrical tube. The tube material is assumed to behave as an isotropic work-hardening, elastic-plastic solid, for which the stress-strain curve in simple tension is a smooth curve, concave toward the strain axis. The resulting equations are shown to yield two wave speeds, C_f and C_s, which satisfy the inequalities $C_2 \leq C_f \leq C_0$ and $C_s \leq C_2$ where C_2 is the elastic shear wave velocity and C_0 is the elastic bar velocity. The solution is given for combined longitudinal and torsional step loading of a semi-infinite tube, which is initially at rest and either unstressed or statically pre-stressed to arbitrary values of normal stress and shear stress. The solution consists of adjoining centered simple wave solutions and constant state solutions. There are two types of simple wave solutions corresponding to the two wave speeds C_f and C_s. The stress paths in stress-space associated with these two types of simple waves form an orthogonal network. Author (TAB)

N66-36403# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
AXISYMMETRIC BUCKLING OF ORTHOTROPIC CIRCULAR PLATES WITH VARIABLE THICKNESS
Sharad A. Patel and Franklin J. Broth Jun. 1966 29 p refs (Contract Nonr-839(40) FBM)
(PIBAL-920; AD-634732) CFSTI: HC $2.00/MF $0.50

This report is concerned with the axisymmetric buckling of an orthotropic circular plate having variable thickness. The thickness varies in the radial direction and the plate is subjected to a uniform edge compression. The governing equation for the stress distribution due to edge compression is derived and solved in terms of a power series in the radial coordinate. With the use of this stress distribution, the equation governing the buckling of the plate is derived. It is solved by Galerkin's method for a clamped plate as well as for a simply-supported plate. Values of the buckling loads thus obtained for a uniform thickness plate agree well with existing results. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-35361# Naval Research Lab., Washington, D. C.
ISENTHALPIC SOLIDIFICATION AND THE SPECIFIC HEAT OF SUPERCOOLED LIQUID PHOSPHORUS
M. E. Glicksman and R. J. Schaefer (NAS-NRC) *In its* Rept. of NRL Progress Jun. 1966 p 7–11 refs (See N66-35359 21-33) CFSTI: $ 125

Isenthalpic solidification of a unary (one component) supercooled liquid results in either two-phase invariant equilibrium or in single-phase univariant equilibrium, depending on the degree of supercooling prior to solidification. When post-solidification univariant equilibrium obtains, a determination of the specific heat at constant pressure, C_p, of the supercooled phase relative to the stable, solid phase can be made by measuring the adiabatic temperature rise during recalescence. Values of C_p for highly supercooled phosphorus over the temperature range -1 to $+18$°C have been determined with this method. No evidence for the changes in molecular association deduced from earlier viscosity data on supercooled phosphorus was found in the temperature variation of the specific heat function. The enthalpy and specific heat values determined for supercooled liquid phosphorus agree with published values for the stable liquid above the normal melting point, $T_o = 44$°C. Author

N66-35544# Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences.
NON-STEADY COMBUSTION OF SOLID PROPELLANTS WITH SPECIAL REFERENCE TO ROCKET INSTABILITY Annual Technical Report, 1 Oct. 1964–30 Sep. 1965
Herman Krier, Gerald di Lauro, Lubomyr Kurylko, and Martin Summerfield Mar. 1966 38 p refs *Its* Aerospace and Mech. Sci. Rept.-773
(Contract AF 49(638)-1405)
(AFOSR-66-1099; AD-634988) CFSTI: HC $2.00/MF $0.50

A prominent mode of coupling that may drive a solid-propellant rocket motor into instability is the interaction between the oscillatory gas dynamic pressure at the burning surface and the instantaneous rate of the oscillatory pressure fluctuations and of rapid monotonic pressure increases are being investigated in a continuing program. Two pieces of apparatus are in use for this purpose. One is the T-tube oscillator. The latter is a chamber with a device to change suddenly on command the throat area of the nozzle to produce pressure rise times of 8,000 psi per second and less. This low range supplements the higher range achievable in the T-tube oscillator. The chamber has three quartz windows which allow luminosity measurements and high speed motion pictures of the propellant flame to be made along with chamber pressure, by varying the chamber volume, and thereby the dp/dt, luminosity versus pressure can be obtained as a function of dp/dt. From this, the temperature is plotted as a function of pressure and dp/dt, and therefore the entropy is plotted as a function of the same variables. The brightness-emissivity method of instantaneous flame temperature measurement is being used. Experiments are being conducted to determine the flame temperature as a function of pressure in various regimes of dp/dt. Author (TAB)

N66-35647*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ANALYSIS AND CORRELATION OF HEAT-TRANSFER COEFFICIENT AND FRICTION FACTOR DATA FOR DILUTE GAS-SOLID SUSPENSIONS
Robert Pfeffer, Salvatore Rossetti, and Seymour Lieblein Washington, NASA, Sep. 1966 62 p refs
(NASA-TN-D-3603) CFSTI: HC $2.50/MF $0.75 CSCL 20M

Literature on heat transfer and pressure drop in the flow of a dilute gas-solid suspension was analyzed. This study obtained workable correlations for predicting some of the basic thermophysical properties and both the heat-transfer coefficient and the friction factor for the flow of suspensions in tubes. Investigated were bulk density, specific heat, thermal conductivity, viscosity, specific heat ratio, and sonic velocity. Loading ratio (solid to gas), the ratio of particle to gas specific heat, and gas Reynolds number, and the particle diameter were considered as variables. Two possible correlations for the convective heat-transfer coefficient of a suspension resulted from this analysis; both indicated that the ratio of suspension to pure gas heat-transfer coefficient increased with loading ratio and specific heat ratio, decreased with increasing gas Reynolds number, and was unaffected by particle diameter for the range considered. The Reynolds analogy was applied to these heat-transfer relations, and a correlation for the ratio of suspension to gas equivalent friction factor was obtained. The ratio of the suspension friction factor to the pure gas friction factor was found to increase with loading ratio and decrease with gas Reynolds number and to be unaffected by particle diameter. This correlation was found to agree with experimental data and an analytical study based on an eddy viscosity model. Author

N66-35661*# TRW Systems, Redondo Beach, Calif.
DETERMINATION OF THERMOPHYSICAL PROPERTIES OF ABLATIVE MATERIALS. PHASE I: LABORATORY DETERMINATIONS. PART A: HEAT CAPACITY, DENSITY, DECOMPOSITION AND MELT TEMPERATURE
J. L. Blumenthal, R. D. Larson, and R. C. Nordberg 1 Jul. 1966 79 p
(Contract NAS9-4518)
(NASA-CR-65486; TRW-04812-6001-R000) CFSTI: HC $2.50/MF $0.75 CSCL 20M

This report describes the work to perform laboratory measurements of thermophysical properties of three ablative materials being used on the Apollo Spacecraft primary propulsion systems. Two additional materials were also evaluated which have potential as improved ablative materials for Apollo applications. The thermophysical properties reported here are comprised of heat capacity, density, decomposition temperature and melt temperature. The thermophysical properties were determined on Fiberite Corporation MX 2600 and MX 2646, Western Backing Corporation WBC 2234 and WBC 5217, and U. S. Polymeric Corporation XR

2015. Descriptions of the experimental techniques and interpretation and discussions of the test results are presented for each of the thermophysical properties. Author

N66-35668# Royal Aircraft Establishment, Farnborough (England).
AN APPRAISAL OF A PROPANE BOILER SYSTEM FOR GAS JET CONTROL OF SPACECRAFT
R. Hastings Mar. 1966 45 p refs
(RAE-TR-66067) CFSTI: HC $2.00/MF $0.50

The feasibility of a heat sink boiler for use with a satellite propane gas jet control system is discussed. Problems of design, construction and heat flow are described, and an estimate made of the possible boiler performance. Results of an experiment to determine the most suitable pipe for such a boiler are presented. Author

N66-35715# Argonne National Lab., Ill.
CORRELATION OF THE HEAT TRANSFER PROPERTIES AND ULTRASONIC TRANSMISSION PROPERTIES OF BONDS
Roberta Ann di Novi Feb. 1966 24 p refs
(Contract W-31-109-ENG-38)
(ANL-7074) CFSTI: HC $1.00/MF $0.50

Two types of bonds, mechanical bonds in the form of copper braze-bonded specimens and roll bonds in the form of Borax fuel-plate sections, were investigated. The thermal-pulse method was utilized for measuring the thermal properties and a through-transmission method was employed for the ultrasonic measurements. The amplitude of the transmitted ultrasonic pulse decreased with a decrease in the heat transfer properties of the copper braze-bonded specimens. This relation was strongly frequency-dependent; the rate of loss of ultrasonic transmission decreased as the wavelength decreased. Unless a definite relation was established between the thermal conductivity and the ultrasonic transmission of each particular bonded fuel-plate section, it was not possible to predict the exact heat transfer properties from the ultrasonic properties. NSA

N66-35723# Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences.
ON THE COMBUSTION OF METALS First Annual Progress Report, 1 Jul. 1964–30 Jun. 1965
J. G. Hansel, M. Zwillenberg, A. M. Mellor, H. F. Sullivan, and I. Glassman Aug. 1965 38 p refs Prepared for Sandia Corp.
(Contract AT(30-1)-3451)
(SC-DC-65-1691) CFSTI: HC $2.00/MF $0.50

The combustion of resistively heated metal wires or strips was examined in a controlled atmosphere chamber capable of operating at elevated or reduced pressures. Metals which burn primarily at the surface, such as tantalum, molybdenum, and zirconium, and metals which burn primarily in the vapor phase, such as calcium and magnesium, were studied. Various gaseous atmospheres were used, the components of which were oxygen, nitrogen, carbon dioxide, water vapor, and argon. Results are interpreted in terms of Glassman's hypotheses of metal burning. Preliminary experimentation of the determination of metal flame temperatures and of ignition processes on a flat flame burner is discussed. Author (NSA)

N66-35741# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
THE INTERACTION OF F FINITE AMPLITUDE PRESSURE DISTURBANCE WITH A COMBUSTION REGION
G. M. Lehmann Jan. 1966 199 p refs
(Contract Nonr-1100(21)– Grant AF-AFOSR-753-65)
(JPC-418; TM-66-1; AD-482941)

The interaction process is studied by analyzing the interaction of a nonuniform shock with the combustion region at the surface of a burning solid propellant. The postulated region comprises (1) a decomposition zone, (2) an induction zone, and (3) a flame zone. Numerical integration was performed for steady state combustion pressures of 250, 500, and 1000 psia. The results, given as the ratio of the amplitude of the shock front after the interaction to the amplitude before interaction, indicated that: (1) the ratio decreases with increasing initial amplitude; and, (2) for a giveninitial amplitude, the amplification of the shock decreases with increasing combustion pressure. The individual effects of processes in the combustion region are discussed. It was concluded that the results are consistent with experimental data for T-burners and with data from pulsing burning propellants with a nonuniform shock. N.E.N.

N66-35747# Southwest Research Inst., San Antonio, Tex.
A SURVEY OF THE LITERATURE ON LIGHT INITIATION OF SILVER ACETYLIDE-SILVER NITRATE EXPLOSIVE
Sandor Silverman Dec. 1965 39 p refs
(TR-1)

Various pertinent properties of a sheet explosive, lead azide, and silver acetylide–silver nitrate explosives are compared; results show that the impulse obtained from the silver acetylide–silver nitrate is about a factor of 44 less than that of lead azide, and a factor of 90 less than the sheet explosive. Other promising applications are listed as explosive forming of metals; dynamic material testing; military applications; and use as a primary explosive. Literature pertaining to light initiation of explosives are assessed, and a reference bibliography is included. Five methods of obtaining the spectral radiant energy incident upon the explosive are also discussed. Proposed recommendations for further research on silver acetylide–silver nitrate explosive include particle size reduction; dyes for increase light energy absorption; and baffles for isolating shock overpressure effects and emitted light on the propagation rate. M.G.J.

N66-35778*# National Bureau of Standards, Boulder, Colo. Cryogenic Data Center.
CRYOGENIC DATA CENTER ACTIVITIES Semiannual Progress Report, 1 Jan.–30 Jun. 1966
V. J. Johnson, R. B. Stewart, and N. A. Olien 30 Jun. 1966 24 p refs
(NASA Order R-06-006-046)
(NASA-CR-77574; NBS-9254) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Progress of the data evaluation and compilation efforts on the following tasks is reported: (1) Thermodynamic properties of hydrogen in the solid, liquid, and gaseous phases from 4° to 300°K (this work includes consideration of the ortho-para and isotopic modifications); (2) Thermodynamic properties of oxygen (compilation work completed); (3) Thermodynamic properties of argon in the solid, liquid, and vapor phases from 20° to 300°K; (4) Saturation and fixed point properties of cryogenic fluids for the liquid-vapor, solid-vapor, and solid-liquid transitions; (5) Viscosity and thermal conductivity of cryogenic fluids; and (6) Physical equilibria and thermodynamic and transport properties for binary mixtures of the cryogenic fluids. Included are sample T-S and P-Z charts for oxygen and sample tables of viscosity for oxygen and nitrogen. The Documentation Unit reports that distribution of the Weekly Current Awareness Service has increased from about 350 copies per week to nearly 1000; that new assessions increased 47% over the previous period with 4348 items being processed in this six months period; and that there has been 73% increase in bibliographic searches with 38 major searches completed. During this period a total of 821 orders were filled with 5938 items, a 3% increase over the previous period. The report includes a summary chart for the status of data compilation tasks, a list of thermodynamic charts that have been prepared and a list of 30 publications and reports issued by the Cryogenic Cryogenic Data Center. Author

N66-35790*# Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences.
NONLINEAR ASPECTS OF COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS Sixth Yearly Progress Report, 1 Jun. 1965–31 May 1966

David T. Harrje and William A. Sirignano 1 Jun. 1966 95 p refs /ts Rept.-553-F
(Contract NASr-217)
(NASA-CR-77672) CFSTI: HC $3.00/MF $0.75 CSCL 21I

Theoretical and experimental studies regarding nonlinear aspects of combustion instabilty in liquid propellant rocket motors are presented. Mathematical treatments of longitudinal shock wave combustion instability and of nonlinear dissipation in acoustic liners are given. Experimental studies for determining the mechanisms involved in nonlinear combustion instability include: (1) transverse mode and longitudinal nonlinear rocket studies, (2) nonlinear displacement effects, (3) droplet distribution studies, and (4) techniques for investigating the combustion process. A linearized mathematical treatment of quasi-steady droplet burning is also given, and nonlinear quasi-steady droplet vaporization is discussed. Data curves from the experiments are given. L.S.

N66-35881# Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.
NONUNIFORM HEAT GENERATION EXPERIMENTAL PROGRAM Quarterly Progress Report No. 10, Oct.–Dec. 1965
[1966] 32 p refs
(Contract AT(30-1)-3238)
(BAW-3238-11; EURAEC-1554) CFSTI: HC $2.00/MF $0.50

During this period, data were obtained on an annular test section having both surfaces heated. The experiments through December included all parameters, but the time permitted evaluating only the 1500 psia data before the end of the quarter. An additional task, a feasibility study of an analytical burnout model, was completed. Author (NSA)

N66-35995# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
DETONATION INITIATION IN ALKANE-OXYGEN MIXTURES
Elton L. Litchfield and Marilyn H. Hay 1966 14 p refs
(BM-RI-6840)

Techniques for direct initiation of detonation have been applied to gaseous mixtures of oxygen with methane, ethane, propane, butane, or hexane. An exploding wire was used as the initiation source to determine minimum stored electrical energies required to effect detonation of mixtures between one-half and two times the stoichiometric fuel ratios. Detonations were obtained in the most easily initiated mixtures of ethane, propane, butane, and hexane for initiation energies between 24 and 33 joules at 1 atm and 28–43 joules at 0.5 atm initial pressure. Methane mixtures, at 1 atm, were not observed to detonate when initiated with up to 484 joules. Author

N66-36000# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
RESEARCH AND TECHNOLOGIC WORK ON EXPLOSIVES, EXPLOSIONS, AND FLAMES: FISCAL YEAR 1965
1966 28 p refs
(BM-IC-8308)

Work in combustion and explosives research centered on improved safety in operations using explosives in underground mines, improved understanding of fire and explosion hazards of flammable industrials materials, and the controlled application of combustion and detonation processes in the space program. Flammability characteristics of several propellant systems were evaluated over a range of pressures and temperatures with emphasis on the operational safety involving hydrogen handling. The initiation of solid explosives by gas detonations was studied and equivalence ratios were determined between the concentration of coal dust and methane at ignition limit. Also included are brief abstracts of 1965 publications on explosives, explosions, and flames. G.G.

N66-36060# Atlantic Research Corp., Alexandria, Va.
FUNDAMENTALS OF COMBUSTION OF SINGLE ALUMINUM AND BERYLLIUM PARTICLES
Andrej Maček Jun. 1966 38 p refs Presented at the 11th Symp. on Combust., Berkeley, Calif., 14–20 Aug. 1966
(Contract Nonr-3623(00); Proj. Squid)
(ARC-9-P; AD-485182)

The purpose of this paper is a comparative examination of ignition and combustion characteristics of small (<100-μ diameter) single aluminum and beryllium particles burning in gaseous environment of known composition and temperature. The comparative discussion covers both new and previously published information. It is concluded that the processes leading to ignition of both metals are strongly affected by physical properties of the respective stable oxides. The results of self-sustained combustion studies, including quantitative burning rate data, indicate that both metals probably burn by the vapor-phase mechanism, controlled by the diffusion of oxidant through the gas. Spherical combustion models are only approximately correct, because there is always a certain geometrical asymmetry during the burning stage, but the approximation can be quite good. The major cause of asymmetry is probably condensation of nascent oxide on the parent particle. Author (TAB)

N66-36076*# Pennsylvania Univ., Philadelphia.
THE DETERMINATION OF THERMAL DIFFUSIVITIES OF THERMAL ENERGY STORAGE MATERIALS. PART 1; SOLIDS UP TO MELTING POINT
Han Chang, Manfred Altman (Nucl. Mater. and Equipment Co.), and Ram Sharma [1964] 38 p refs
(Grant NsG-316)
(NASA-CR-77797) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A method is described for determining thermal diffusivities in substances which are poor conductors, and which have high melting points. The basic principle involved consists of raising the surface temperature of a solid specimen at a uniform rate. After the initial transients have died out, the diffusivity can be determined from temperature measurements alone. Thermal diffusivity measurements were tabulated for aluminum oxide and lithium fluoride, and several graphs of the test data are presented. It is concluded that the experimental method is feasible for application to temperatures up to 2000° C, and that operation in a vacuum is not essential to the technique. A.G.O.

N66-36093*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLUTION OF RAREFIED GAS TRANSPORT PROBLEMS
Morris Perlmutter Washington, NASA, 1965 28 p refs Presented at the Am. Soc. of Mech. Engr. Winter Ann. Meeting, Chicago, 7–11 Nov. 1965
(NASA-TM-X-52110) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A discussion of application of the Monte Carlo method to rarefied gas heat transfer is given. A sample problem of heat transfer through a rarefied gas between infinite flat plates is treated. Hard sphere molecular collisions and a wall accommodation coefficient of 1 are assumed. The target molecule distribution is assumed to be Maxwellian. The results are compared to approximate analytical methods and to another Monte Carlo solution. Author

N66-36106*# Boeing Co., Seattle, Wash.
ANALYSIS OF HYPERSONIC PRESSURE AND HEAT TRANSFER TESTS ON DELTA WINGS WITH LAMINAR AND TURBULENT BOUNDARY LAYERS Final Report
A. L. Nagel, H. D. Fitzsimmons, and L. B. Doyle Washington, NASA, Aug. 1966 199 p refs
(Contract NAS1-4301)
(NASA-CR-535) CFSTI: HC $5.00/MF $1.25 CSCL 01A

Results are presented of an analysis of slab delta wing pressure and heat transfer data with laminar and turbulent boundary layers. The data were obtained during the X-20 (Dyna-Soar) program

from a parametric series of models tested in conventional wind tunnels at Mach numbers of 6, 7, and 8. Shock tunnel data at Mach numbers of 6 and 15 and shock tube data at a Mach number of 2.2 are also presented. All tests were in air. Turbulent leading edge heating data at Mach numbers of 6 and 8 with wing sweep angles up to 78° and wing angles of attack of up to 45° are compared to swept cylinder theory. Laminar and turbulent heat transfer data from blunt and sharp prow delta wings at angles of attack to 30° are also presented. Lower surface centerline heating data at angles of attack up to 45° are compared to two and three dimensional theories. The effect of lower surface ramp angle and a dual radius leading edge are illustrated by pressure and heating data comparisons with the blunt delta wing and cylindrical leading edge data. Streamline data taken by a direct transfer oil flow technique are presented for both blunt prow and sharp prow delta wings. Author

N66-36107*# Boeing Co., Seattle, Wash.
ANALYSIS OF HYPERSONIC PRESSURE AND HEAT TRANSFER TESTS ON A FLAT PLATE WITH A FLAP AND A DELTA WING WITH BODY, ELEVONS, FINS, AND RUDDERS Final Report
H. L. Giles and J. W. Thomas Washington, NASA, Aug. 1966 126 p refs
(Contract NAS1-4301)
(NASA-CR-536) CFSTI: HC $4.00/MF $1.00 CSCL 01A

Results are presented of an analysis of hypersonic boundary layer separation and flow field interference data taken during the X-20 (Dyna-Soar) program. Pressure and heat transfer data were taken on a sharp flat plate at Mach numbers of 6.38 and 15.15 and Reynolds numbers per foot, based on model length, of 1.404×10^7 and 1.12×10^5 respectively, in the Cornell shock tunnel. A body with a canopy windshield and swept vertical fins was tested on the blunt delta wing model to evaluate interference. Laminar and transitional separation plateau pressure data are compared with results obtained using existing two-dimensional theoretical and empirical methods. The areas of separation on the blunt delta wing are defined. Boundary layer separation lengths are compared with two-dimensional analytical results and are empirically correlated with a modified theoretical relation. Peak pressures on the elevon are compared with an attached-flow theory. Theoretical heating rate predictions are compared with test data. Pressure and heating on the expansion side of a sharp flat plate are compared with a viscous theory. Interfering flow effects are found to be extremely complex and cannot be predicted by existing techniques. Author

N66-36108*# Boeing Co., Seattle, Wash.
ANALYSIS OF PRESSURE AND HEAT TRANSFER TESTS ON SURFACE ROUGHNESS ELEMENTS WITH LAMINAR AND TURBULENT BOUNDARY LAYERS Final Report
C. L. Jaeck Washington, NASA, Aug. 1966 146 p refs
(Contract NAS1-4301)
(NASA-CR-537) CFSTI: HC $4.00/MF $1.00 CSCL 01A

An analysis is presented of data obtained during the X-20 program in which the effect of surface roughness on heat transfer and pressure was measured. Experimental data for both laminar and turbulent flow and at Mach numbers from 6.9 through 15 are presented for three basic types of surface distortions: (1) surface waves, (2) grooves or cavities, and (3) aft facing steps. Data are compared with theory and previously published empirical approaches. In the case of surface waves, laminar heat transfer data are compared with a shallow wave theory presented in an appendix of this report. Turbulent flow over waves was also studied. The laminar shallow wave theory was empirically extended to turbulent flow using both X-20 and NASA data. The maximum increase in laminar heating rate for grooves and cavities was correlated using a Nusselt number based on cavity width in the direction of flow. The data correlated in this manner show that the heating increases as width to depth ratio is decreased. Data are also presented for an aft facing step on a hemicylinder leading edge. Autho

N66-36125*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND-TUNNEL INVESTIGATION OF THERMAL AND PRESSURE ENVIRONMENTS IN THE BASE OF THE SATURN S-IC BOOSTER FROM MACH 0.1 TO 3.5
Robert A. Wasko Washington, NASA, Sep. 1966 21 p refs
(NASA-TN-D-3612) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A 1/45 scale model of the Saturn S-1C booster was tested from Mach 0.1 to 3.5 and at altitudes from sea level to 150,000 feet in order to examine trends in convective and radiative heating rates and in pressures in the base region as affected by model geometric variations such as engine shroud length, introduction of cooling air into the base, and nozzle gimbal angle. The effects of a non-operating center engine were also determined. Results indicate that trends in convective and radiative heating agree with predicted trends. Convection reached a maximum at transonic Mach numbers and low altitudes and decreased to low values at supersonic Mach numbers and high altitudes, whereas radiation was maximum near sea level and decreased with increasing altitude. Changes in model geometry tended to decrease heating rates from values obtained for the configuration with the longest shroud and without base-cooling-air devices. However, at high altitudes a shorter shroud increased heating as did certain nozzle-gimbal patterns. Maximum convective heating rates tended to occur at a base location between the outboard nozzles, while radiation reached a maximum further outboard. Base pressure was less than free-stream static pressure and was nearly constant across the base at altitudes to 36,000 feet. At higher altitudes, it was greater than ambient and decreased in magnitude from the inner to the outer region of the base. Author

N66-36154# Oklahoma State Univ., Stillwater. School of Mechanical Engineering.
THERMAL DESIGN OF HYDRAULIC CIRCUITS
Jerald D. Parker and Faye C. Mc Quiston Jul. 1964 111 p refs Prepared for Boeing Co. Available from Okla. State Univ. Stillwater: $3.00
(Publ.-142)

Discussed are some of the factors which determine the maximum permissible fluid temperature in hydraulic systems and possible steps that can be taken to control or modify the systems temperatures. Fluid contaminstion by sludge and harmful deposits and temperature-dependent fluid property variations were considered, as well as the proper selection of components and structures in hydraulic systems for aircraft pumps in extreme environments. Several example temperature computations for hydraulic systems with variable displacement pumps, optimum bleed flow rate, and heat exchanger have been included. G.G.

N66-36200# California Univ., Berkeley. Coll. of Engineering.
ANALYTICAL AND EXPERIMENTAL STUDY OF TRANSIENT HEAT TRANSFER FOR EXTERNAL FORCED CONVECTION
Mojstafa Soliman (Ph.D. Thesis) Jan. 1966 237 p refs
(Contract AT(11-1)-34)
(SAN-1011; TS-68-1) CFSTI: HC $6.00/MF $1.25

An exact solution, for the wall heat flux, is presented for the problem of transient forced-convection heat transfer when the velocity profile is linear and the shear stress varies very slowly along the wall (Transient Leveque Problem), the surface temperature undergoes a step jump with time. The solution is obtained by double Laplace transformation methods. Asymptotic expressions are presented for the solution at small and large times. Next, an approximate analysis is presented to predict the transient local and mean wall temperatures of a flat plate cooled on both sides by a steady incompressible turbulent

flow of Prandtl number unity. The plate is heated by a uniform heat source which undergoes either a step jump or an exponential rise with time (q_0e^{t/t_0}). The effect of the thermal capacity of the plate is included. Experimental data are presented for the transient mean wall temperatures of thin metallic ribbons simulating the analytical model and cooled by a flow of water. NSA

N66-36233# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SECOND ALL UNION CONFERENCE ON THERMO- AND MASS EXCHANGE
I. T. El'perin and G. D. Rabinovich 21 Jan. 1965 24 p refs Transl. into ENGLISH from Inshenerno-Fiz. Zh. (Minsk), no. 10, 1964 p 130–135
(FTD-TT-65-1475; AD-633659) CFSTI: HC $1.00/MF $0.50

The purpose of the conference was to evaluate greater theoretical and experimental material on different chapters of thermo- and mass exchange, accumulated during the past three years, and also the sedlection of basic trends of further investigations. TAB

N66-36253# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
ANALYSIS OF AXISYMMETRIC FREE TURBULENT ROTATING JETS
N. A. Chigier and D. H. Lorenz [1066] 24 p refs Presented at the Israel Mathematical Union Meeting on Hydrodyn., Rehovot, Israel, 2 Jun. 1966 Submitted for Publication.
(TAE-50) CFSTI: HC $1.00/MF $0.50

Analysis is made of the Reynolds' equations of motion for turbulent axisymmetric jet flows in which the swirl velocity component is non-vanishing. A separation of variables is introduced into the equations of motion and continuity, and after some re-arrangement, the equations are integrated over the width of the turbulence region. Similarity of the transverse distributions of velocities, pressure and turbulence quantities allows the definition of a set of functions which are invariant along the main flow direction. The theory results in a 2nd order non-linear differential equation describing the changes in the axial direction of the maximal axial velocity component. The maximal radial velocity, azimuthal velocity and relative pressure can then be simply related to the axial component. Experimental results on turbulent swirling jets are used to compute the constants appearing in the equations. For weak degrees of swirl the assumptions usually made in the boundary-layer-approximations are valid. Author

N66-36305*# Lockheed Missiles and Space Co., Palo Alto, Calif.
RADIANT ENERGY TRANSFER MEASUREMENTS IN AIR
H. Hoshizaki, A. D. Wood, J. C. Andrews, and K. H. Wilson Washington, NASA, Sep. 1966 110 p refs
(Contract NAS7-359)
(NASA-CR-585) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Experimental data were obtained on the integrated intensity of high temperature air, including the vacuum ultraviolet, under conditions similar to those encountered during superorbital entry by full scale vehicles. The experiments were carried out in arc driven shock tubes, and a gage-in-cavity model was used to measure the total intensity as a function of gas path length. Continuum and line radiation, gage surface absorption, cavity plume effect, orifice outflow effect, and radiation cooling and non-equilibrium radiation were analyzed. It was concluded that the vacuum ultraviolet is a significant contributor to the integrated radiative heating of entry vehicles, and that self-absorption is an important mechanism in reducing the radiative heating. Formulas for continuum absorption coefficients of nitrogen and oxygen, and stream tube chemistry calculations are also included. A.G.O.

N66-36320*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
APOLLO AFTERBODY HEAT TRANSFER AND PRESSURE WITH AND WITHOUT ABLATION AT M_∞ OF 5.8 TO 8.3
George Lee and Robert E. Sundell Washington, NASA, Sep. 1966 44 p refs
(NASA-TN-D-3620) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Apollo afterbody pressures and heat transfer with and without an ablating nose cap have been measured at Mach numbers 5.8 to 8.2, stream enthalpies of 1.628×10^6 to 9.296×10^6 J/kg, and Reynolds numbers based on diameter of 200 to 22,000. Correlations of the data and comparisons with theories have been made. Author

N66-36382# France. Ministe de l'Air, Paris.
THE PROBLEM OF THE HETEROGENEOUS FINITE WALL EXECUTED BY THE HEAT IMPULSE EQUATION. APPLICATION TO THE E. CALVET MICROCALORIMETER [LE PROBLEME DU MU HETEROGENE FINI TRAITE PAR L'EQUATION IMPULSIONNELLE DE LA CHALEUR. APPLICATION AU MICROCALORIMETRE E. CALVET]
Robert Roux (Inst. de Microcalorimetrie) May 1966 66 p refs In FRENCH
(NT-152) CFSTI: HC $3.00/MF $0.75

The simplified theory of the microcalorimeter, treated by the impulse method as a finite heterogeneous wall, is given, along with details of the calculations to permit a complete interpretation of thermograms. The application to any type of finite wall in a variable system is discussed. A comparison of theoretical and experimental data gave satisfactory results. It is felt that the microcalorimeter is one of the instruments most adaptable to the analysis of thermogenesis. Consideration is also given to the influence of heat losses through mica thermocouples, and to parasite thermal efficiencies. Experimental results show that perturbations from mica are negligible, and that corrections of theoretical temperatures are significant. Transl. by R. U.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-35359# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS, JUNE 1966
Jun. 1966 44 p refs
(PB-170600) CFSTI: $1.25

CONTENTS:

1. LIQUID NITROGEN COOLED TELESCOPE FOR ROCKET INFRARED ASTRONOMY D. P. McNutt, M. Harwit (Cornell Univ.), K. Shivanandan, B. J. Zajac (Maryland Univ.), and P. P. Feldman p 1–6 refs (See N66-35360 21-14)
2. ISENTHALPIC SOLIDIFICATION AND THE SPECIFIC HEAT OF SUPERCOOLED LIQUID PHOSPHORUS M. E. Glicksman and R. J. Schaefer (NAS-NRC) p 7–11 refs (See N66-35361 21-33)
3. PROBLEM NOTES p 12–37 refs
4. SUPPORTING TECHNIQUES p 37–38

N66-35377# Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 337
19 Aug. 1966 50 p refs Transl. into ENGLISH from Chinese journals
(JPRS-37134; TT-66-33563) CFSTI: $2.00

CONTENTS:

1. THE THEORETICAL PROBLEMS ON THE DETERMINATION OF SEA GRAVITY BY USING A HIGH DAMPING GRAVIMETER H.-c. Li p 1–19 refs (See N66-35378 21-13)

2. ONE METHOD OF REALIZATION OF WIDE-BAND 90° PHASE SHIFT NETWORKS J.-s. Wang, C.-p. Hsieh, T. Hsun, and I.-c. Hsue p 20–30 refs (See N66-35379 21-07)

3. THE REALIZATION OF THE CODING PULSE COMPRESSION WITH MULTIPLE-TAPPED DELAY LINES C.-c. Fu and M.-l. Wang p 31–42 refs (See N66-35380 21-07)

4. ACADEMIC MEETING BRIEF NEWS p 43–44

5. PREDICTIONS OF FISH FRY RUNS IN THE YANGTZE RIVER ANNOUNCED BY THE INSTITUTE OF AQUATIC BIOLOGY, CHINESE ACADEMY OF SCIENCES p 45–46

6. A PLATING THICKNESS GAUGE p 47

N66-35477# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY

15 Aug. 1966 14 p Transl. into ENGLISH from Chinese periodicals

(JPRS-36997; TT-66-33427) CFSTI: HC $1.00

CONTENTS:

1. STEROIDS. XLVIII: THE HYDROXYLATION OF $\Delta^{5,16,20}$-PREGNATRIEN-3β, 20-DIOL DIACETATE BY POTASSIUM PERMANGANATE Z.-w. Wang and H. Minlon p 1–8 refs (See N66-35478 21-06)

2. TEMPORARY PULSE TYPE SUPERSONIC WIND TUNNEL C. Yen p 9–12 (See N66-35479 21-11)

N66-35485# Library of Congress, Washington, D. C. Aerospace Technology Div.

NUCLEAR WEAPONS EFFECTS Surveys of Soviet Scientific and Technical Literature

Yuri Ksander 19 Apr. 1966 35 p Compilation of abstracts *Its* Rept.-3

(ATD-66-45; TT-66-61761; AD-635477) CFSTI: HC $2.00/MF $0.50

The report is arranged in three sections. Section I discusses the structure and parameters of shock waves in gases. Section II discusses propagation of strong shock waves and their interaction with materials. The third section discusses shock waves in the stars and interstellar space. TAB

N66-35546*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AERO-ASTRODYNAMICS RESEARCH REVIEW NO. 2, JULY 1–DECEMBER 30, 1964

1 Apr. 1965 156 p refs

(NASA-TM-X-53295) CFSTI: HC $5.00/MF $1.00 CSCL 22A

CONTENTS:

1. NEWTONIAN AERODYNAMICS FOR GENERAL SURFACES W. H. Heybey p 2–10 ref (See N66-35547 21-01)

2. A UNIFIED TREATMENT OF TURBULENT FLUXES IN MULTI-COMPONENT AND HOT FLOWS F. R. Krause and M. J. Fisher (IIT Res. Inst.) p 11–25 refs (See N66-35548 21-12)

3. ON QUASI-SLENDER BODY THEORY FOR OSCILLATING LOW ASPECT RATIO WINGS AND BODIES OF REVOLUTION IN SUPERSONIC FLOW M. F. Platzer p 26–32 refs (See N66-35549 21-01)

4. A NEW PERFORMANCE CRITERION FOR LINEAR FILTERS WITH RANDOM INPUTS M. H. Rheinfurth p 34–51 refs (See N66-35550 21-07)

5. VARIABLE POROSITY WALLS FOR TRANSONIC WIND TUNNELS A. R. Felix p 54–58 refs (See N66-35551 21-11)

6. AUTOMATION OF POST-FLIGHT EVALUATION C. Hagood p 60–64 refs (See N66-35552 21-08)

7. LOCAL MEASUREMENTS IN TURBULENT FLOWS THROUGH CROSS CORRELATION OF OPTICAL SIGNALS M. J. Fisher (IIT Res. Inst.) and F. R. Krause p 66–76 refs (See N66-35553 21-14)

8. HOT WIRE TECHNIQUES IN LOW DENSITY FLOWS WITH HIGH TURBULENCE LEVELS A. R. Hanson, R. E. Larson (Litton Systems), and F. R. Krause p 77–91 refs (See N66-35554 21-14)

9. THEORY AND APPLICATION OF LONG DURATION HEAT FLUX TRANSDUCERS S. J. Robertson (Heat Technol. Lab.) and J. P. Hearman p 92–111 refs (See N66-35555 21-14)

10. A SURVEY OF METHODS FOR GENERATING LIAPUNOV FUNCTIONS C. C. Dearman, Jr. and A. R. LeMay p 114–132 refs (See N66-35556 21-19)

11. AN ORTHONORMALIZATION PROCEDURE FOR MULTIVARIABLE FUNCTION APPROXIMATION H. Ingram p 133–138 refs (See N66-35557 21-19)

12. ANALYSIS OF THE INFLUENCE OF VENTING AND GAS LEAKAGE ON TRACKING OF ORBITAL VEHICLES A. R. McNair and P. E. Dreher p 140–147 ref (See N66-35558 21-07)

N66-35641# Mitre Corp., Bedford, Mass.

AESOP: A GENERAL PURPOSE APPROACH TO REAL-TIME, DIRECT ACCESS MANAGEMENT INFORMATION SYSTEMS

Joseph Spiegel, John K. Summers, and Edward M. Bennett Bedford, Mass. AFSC, Electron. Systems Div., Jun. 1966 38 p Presented at the Am. Management Assoc. Meeting, New York, Feb. 1966

(Contract AF 19(628)-5165)

(MTP-33; ESD-TR-66-289; AD-634371) CFSTI: HC $2.00/MF $0.50

AESOP, a laboratory-based prototype of a general purpose, on-line, visually-oriented information system, is used to investigate ways of handling many different types and levels of command and management problems spanning organizational levels from the executive suite down through the staff and operations analysts to the actual system designers and programmers. In particular, it deals with those organizational activities that require highly flexible, direct-access capabilities. the system is configured for easy use by the inexperienced as well as by the sophisticated, and utilizes a variety of user station devices to facilitate such flexibility, including a cathode-ray-tube display, a lightgun, a typewriter, and associated push-buttons. At each station, it is capable of generating, editing, and formatting information on-line, as well as building, executing, and debugging on-line the analytic and mathematical procedures and algorithms of both the users and the system itself, depending upon the organizational area or level of the user. Although the basic prototype system was developed for use in military command and management planning and information systems, its philosophy and concepts are applicable to industrial and academic organizations. Author (TAB)

N66-35789*# Washington Univ., St. Louis, Mo. Dept. of Economics.

STARTING SALARIES OF ENGINEERS AND SCIENTISTS

Hugh Folk Aug. 1966 28 p refs *Its* Working Paper 6606

(Grant NsG-342)

(NASA-CR-77677) CFSTI: HC $2.00/MF $0.50 CSCL 05C

Changes in starting salaries of engineers and scientists during the postwar period are examined. Discussed are patterns of demand that have affected the market for engineers and scientists since World War II, changes in starting salaries of

engineers relative to other occupations, changes within the field of engineering, and changes in the structure of engineers' salaries.
S.C.W.

N66-35961*# George Washington Univ., Washington, D. C.
AN INVESTIGATION OF PROFIT RATES IN DEFENSE CONTRACTING
Charles E. Bradley, Kate A. Arbogast, Patrick Ross Huntley, and Clayton C. Mc Cuistion [1966] 132 p refs
(Grant NsG-425)
(NASA-CR-77868) CFSTI: HC $3.00/MF $1.00 CSCL 05C

An examination is presented of the cost of capital in selected industry groups, with emphasis placed on firms primarily involved with government contracting. Time series data and the customary ratio analysis for specific industry groups are given. An evaluation is shown of the overall profit outcomes in terms of a general measure of the cost of capital for the groups developed. Adaptations are made of models which capital theorists offer as descriptive of market behavior and normative for managerial decisions. A test is presented of the reasonableness of profits for renegotiation board objectives, and a summary description of the various profit theories of economics is included.
C.T.C.

N66-35974*# George Washington Univ., Washington, D. C.
PRODUCTIVITY OF FEDERALLY FINANCED RESEARCH AND DEVELOPMENT Final Report, May 15, 1963–May 14, 1966
Donald S. Watson [1966] 12 p
(Grant NsG-425)
(NASA-CR-77776) CFSTI: HC $0.00/MF $0.50 CSCL 05A

Four studies conducted under the auspices of NASA are discussed: (1) a study of patents resulting from government-financed research and development, with data categorized as to personnel, federal agencies, and patent policies; (2) a study of the concentration of patents from government-financed research in industry, which treats government contract policies, monopoly power, and patent generation by 177 major contractors during a 17-year period; (3) a study of the federal government's propensity to patent, which analyzes the relative decrease in patents during the postwar period despite the increase in the number of scientists, engineers, and the greatly increased financial outlay; and (4) an incomplete study of the concentration of patents owned by domestic corporations, which spans four decades.
K.W.

N66-35998# Louisiana State Univ., Baton Rouge. Div. of Engineering Research.
THE EFFECT OF ADMIXTURES ON LAYERED SYSTEMS CONSTRUCTED WITH SOIL-CEMENT
Ara Arman and Terry J. Dantin 1965 88 p refs
(PB-169112) CFSTI: HC $6.50/MF $1.25

It is the purpose of this treatise to present a method for the analysis and design of a layered soil-cement system with the use of a set retarding agent as an admixture. Results for this analysis are obtained from tests of over two thousand specimens molded with Louisiana soils from twenty-six different locations. The tests show that there is a definite increase produced in the shear strength of the layered system by developing a bond between adjacent layers of a soil-cement stabilized system with the addition of Calcium Lignosulfonate and Hydroxylated Carboxylic Acid for soils of low plasticity with the exception of pure silts.
Author

N66-36079*# Washington Univ., St. Louis, Mo. Dept. of Economics.
FEDERAL GOVERNMENT BUDGET TRENDS, 1965–1975
Murray L. Weidenbaum Aug. 1966 72 p refs *Its* Working Paper 6605
(Grant NsG-342)
(NASA-CR-77751) CFSTI: HC $5.00/MF $0.75 CSCL 05C

The prospective emerging developments in Federal Government finance during the 1965–1975 time period are analyzed. The emphasis is on estimating the budget results that are likely to occur, with particular attention to the future effects of existing statutory authorizations and commitments. Estimates of each category of Federal cash receipts were made on the basis of projecting their historical relationships to the gross national product or the relevant derivative series. Federal expenditure projections are included for national defense, international affairs and finance, space research and technology, agriculture, natural resources, commerce and transportation, housing and community development, health, labor, and welfare, education, and veterans benefits. The results of the analysis illuminate the availability of funds for space and other national programs and the types of financial pressures which may influence the allocation of public funds to space and other Federal Government programs.
A.G.O.

N66-36086# Bureau of Naval Personnel, Washington, D. C.
PRINCIPLES OF GUIDED MISSILES AND NUCLEAR WEAPONS
1966 372 p refs Revised
(NAVPERS-10784-A) GPO: $2.00

The basic principles and theories of guided missile flight and control, and basic nuclear weapons information are presented. The fundamentals of different types of missile guidance are discussed. Because of security regulations, only a minimum reference is made to actual weapons in current use. Considerable detail is given to the effects of nuclear weapons.
R.N.A.

N66-36190# Atomic Energy Commission, Washington, D. C. Div. of Research.
SUMMARIES OF THE USAEC BASIC RESEARCH PROGRAMS IN METALLURGY, SOLID STATE PHYSICS AND CERAMICS, FISCAL YEAR 1965
Jan. 1966 485 p refs
(TID-46005, Pt. I, 9th ed.)

The summary covers the fiscal year 1965 and is divided into two parts according to research done in AEC laboratories and elsewhere.
NSA

N66-36193# Army Natick Labs., Mass.
SOURCES OF THERMAL RADIATION FOR NUCLEAR WEAPONS EFFECTS STUDIES
Earl T. Waldron Aug. 1965 10 p refs
(TS-134)

The requirements for simulating a 30-kt weapon are summarized. A number of devices used in the United States to simulate the thermal radiation emitted by nuclear weapons are compared, including arc-image furnaces, solar furnaces, and radiant panels.
NSA

N66-36244# Harry Diamond Labs., Washington, D. C.
A MULTIPLE TESTING OF THE ABC METHOD AND THE DEVELOPMENT OF A SECOND-GENERATION MODEL. PART II: TEST RESULTS AND AN ANALYSIS OF "RECALL RATIO"
Berthold Altmann Oct. 1965 35 p refs
(HDL-TR-1296; AD-625924) CFSTI: HC $2.00/MF $0.50

After a brief summary of the test program, the statistical results tabulated as overall ABC-relevance ratios and ABC-recall figures are presented and reviewed. An abstract model developed in accordance with Max Weber's "idealtypus" (Die Objektivitat sozial wissenschaftlicher and sozialpolitischer erkenntnis; in Gesammelte aufstze zur wissenschaftslehre, 1922, pages 174, 179, 190–191, 194) is used in discussing such observations as the absence of an inverse relationship of relevance and recall ratios.

The increase of recall in proportion to the number of documents located is attributed to the ABC-system's peculiar capability of making the user an integral part of the system. Author (TAB)

N66-36388*# George Washington Univ., Washington, D. C. Dept. of Economics.
AN EVALUATION OF THE PATENT POLICIES OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Final Report
Donald Stevenson Watson, Mary A. Holman, and David E. Aaronson 31 Aug. 1966 221 p refs
(Grant NsG-425)
(NASA-CR-77945) CFSTI: HC $6.00/MF $1.25 CSCL 05A

An investigation of NASA's patent policies is presented under the public interest evaluation criteria of (1) advancement of technology, (2) promotion of agency missions, and (3) contribution to other goals of government. The actual operation of these criteria is analyzed, and the policies are examined with the following tests: disclosure of inventions; utilization of inventions; encouragement of invention development; transfer of technology; best contractors; protection in procurement; protection of health welfare; and avoidance of concentration and monopoly. C.T.C.

N66-36397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPACE AND INTERNATIONAL COOPERATION Selected Articles
25 May 1964 266 p refs Transl. into ENGLISH of "Kosmos i Mezhdunarodnye Sotrudnichestvo" Moscow, Izd. Inst. Mezhdunarodnykh Otnosheniy, 1963 p 1–256
(FTD-MT-64-176; TT-65-62291; AD-615454) CFSTI: HC $6.00/MF $1.50

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1. ON THE 70TH BIRTHDAY OF YEVGENIY ALEKSANDROVICH KOROVIN p 1–8 refs
2. LEGAL REGIME OF OUTER SPACE AT THE CONTEMPORARY LEVEL G. P. Zhukov p 9–46 refs
3. LEGAL REGULATION OF ACTIVITY IN OUTER SPACE I. I. Cheprov p 47–73 refs
4. UN COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE F. N. Kovalev p 74–107 refs
5. ROLE OF SPECIALIZED UN INSTITUTIONS IN THE DEVELOPMENT OF INTERNATIONAL COOPERATION IN MASTERING OF OUTER SPACE FOR PEACEFUL PURPOSES G. S. Stashevskiy p 108–133 refs
6. THE QUESTION OF ASSIGNMENT AND INTERNATIONAL REGULATION OF RADIO FREQUENCIES FOR SPACE SERVICES D. D. Yerigin p 134–157 ref
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9. QUESTIONS OF THE REGIME OF OUTER SPACE IN THE JURIDICAL LITERATURE OF THE GERMAN DEMOCRATIC REPUBLIC A. I. Munder p 186–210 refs
10. QUESTIONS OF COSMIC LAW IN THE LATEST AMERICAN LITERATURE E. G. Vasilevskaya p 211–243 refs
11. INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF OUTER SPACE p 245–258
12. SOVIET LITERATURE ON SPACE LAW p 259–261

N66-36420*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MANUFACTURING RESEARCH AT MSFS Research Achievements Review Series No. 8
1965 43 p
(NASA-TM-X-53505) CFSTI: HC $2.00/MF $0.50 CSCL 13H

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1. INTRODUCTION TO MANUFACTURING RESEARCH AT MARSHALL SPACE FLIGHT CENTER H. F. Wuenscher p 1–2
2. MANUFACTURING RESEARCH IN SUPPORT OF SATURN V J. R. Williams p 3–14 (See N66-36421 21-31)
3. ESTABLISHING A COMMON DENOMINATOR IN WELDING G. Parks p 15–20 (See N66-36422 21-15)
4. RESEARCH IN SUPER POWER LASERS AND INTENSE MAGNETIC FIELDS R. J. Schwinghamer p 21–30 (See N66-36423 21–16)

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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